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Electronics Today INTERNATIONAL

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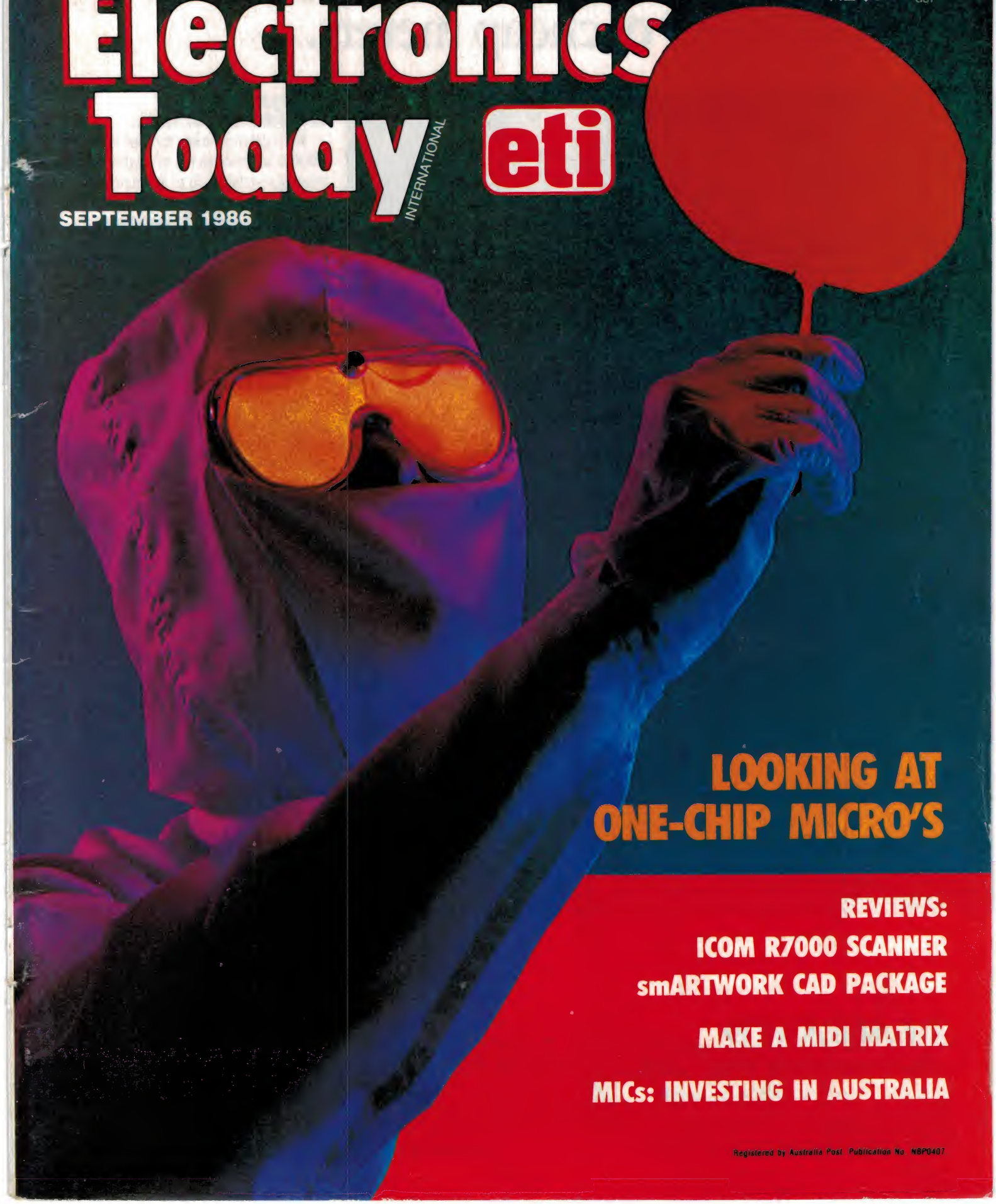
SEPTEMBER 1986



LOOKING AT ONE-CHIP MICRO'S

REVIEWS:
ICOM R7000 SCANNER
smARTWORK CAD PACKAGE

MAKE A MIDI MATRIX

MICs: INVESTING IN AUSTRALIA

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You get what you pay for.
So get the Fluke 70 Series.

You'll get more meter for your money, whether you choose the affordable 73, the feature-packed 75 or the deluxe 77.

All of them will give you years of performance, long after cheaper meters have pegged their fishhook needles for the last time.

That's because they're built to last, inside and out. So they're tough to break. They don't blow fuses all the time. You don't even have to replace batteries as often.

And they're backed by a 3-year warranty. Not the usual 1-year.

Of course, you may only care that the world-champion 70 Series combines digital and analog displays with more automatic features, greater accuracy and easier operation than any other meters in their class.

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Analog/digital display
Volts, ohms, 10A, diode test
Autorange
0.7% basic dc accuracy
2000+ hour battery life
3-year warranty

FLUKE 75
Analog/digital display
Volts, ohms, 10A, mA, diode test
Audible continuity
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0.5% basic dc accuracy
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3-year warranty

FLUKE 77
Analog/digital display
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ELECTRONICS TODAY INTERNATIONAL is published and distributed monthly by the Electronics Division of the Federal Publishing Company Pty Limited, 180 Bourke Road, Alexandria, NSW 2015 under licence from Double Bay Newspapers Pty Limited, General Newspapers Pty Limited and Suburban Publications Pty Limited. Printed by Hannanprint, Sydney. Distributed by Magazine Promotions. *Maximum and recommended Australian retail price only. Registered by Australia Post, Publication No NBP0407. ISSN No 0013-5216.

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FEATURES

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COVER: Courtesy Intel.

Satisfying the most rigorous performance requirements

Peak performance in R.A.M. technology

The F1600 is a 65,536-bit fully static asynchronous random access memory, organized as 65,536 words by 1-bit, using high-performance CMOS technology. The F1600 is based on an advanced isoplanar oxide isolation process: fully-implanted CMOS technology with sub-2 micron design rules and high-performance tantalum silicide interconnects.

We're taking the high ground.

FAIRCHILD

A Schlumberger Company

A top performer- Seeq's E² PROM single chip microcomputer

Todays's self-adjusting carburettor is programmed to manage a car's air-fuel mixture efficiently, no matter what the rigours of the climate . . . programmed with Seeq's E² microcomputer, resulting in a well-controlled engine running smoothly under all driving conditions.

Wherever self-adaptive, in-circuit or remote reprogrammability are called for to satisfy crucial performance requirements, Seeq's 72720 E² microcomputer addresses the challenge.

seeq

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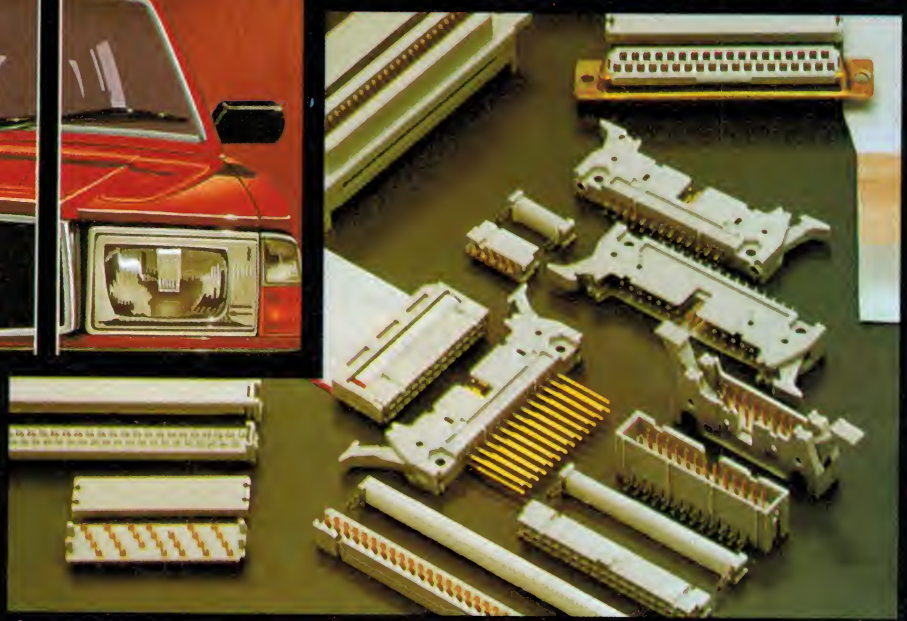

Scotchflex Click Plug Connectors outperform the others

Scotchflex Click Plug Connectors provide mating compatability with Standard socket connectors on 2.54mm x 2.54mm grid spacing. Design applications include use as a T-tap from a cable buss, a splice connector, or I/O and external interconnect application. Use of the Polarizing Key 3518-J and Scothchflex Socket Connector permits easy polarization without pin sacrifice.

Ejector/Latch Clip is attached to Click Plug Connectors and you can easily withdraw Socket, and locking mechanism is also available. Connectors are available with or without mounting flanges.

Scotchflex 3M

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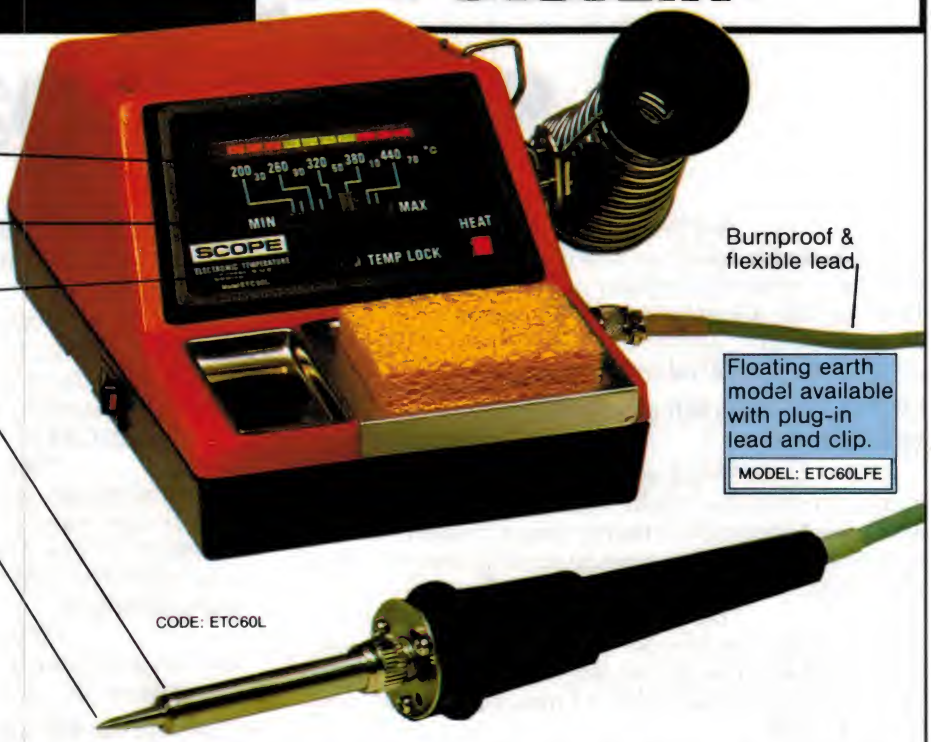
SCOPE

60W SOLDERING SYSTEM



Illuminated Temp. readout monitors actual tip temperature.

Select the tip temp. required.

Zero Voltage switching for maximum component safety.

Ceramic encapsulated element for lowest earth leakage.

60 Watts of back-up power -30W Pencil optional.

Burnproof & flexible lead.

Floating earth model available with plug-in lead and clip.

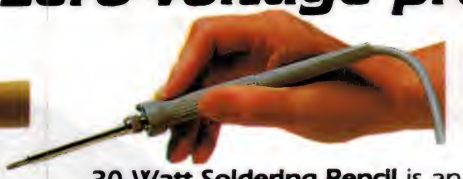
MODEL: ETC60LFE

CODE: ETC60L

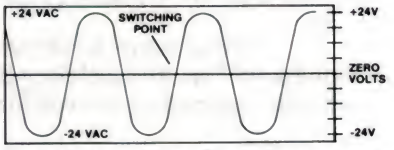
NOW

INFINITELY ADJUSTABLE 200°-470°C
with zero voltage protection

Screw type connector prevents accidental plug removal.



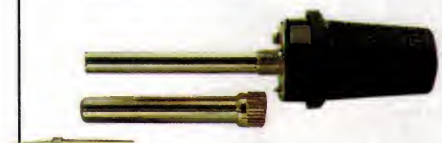
30 Watt Soldering Pencil is an optional tool to replace 60W standard tool. Special miniature tips are available.



Damaging Spikes and induced tip voltages likely to damage MOS devices are virtually eliminated by Z.V.S.* circuitry.

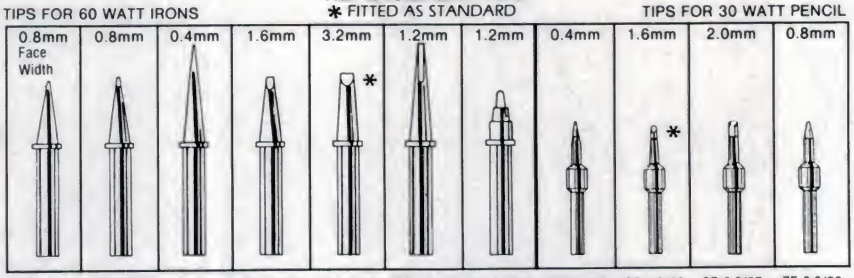
* ZERO VOLTAGE SWITCHING OF HEATER

Anti Seize tip retention design - reduced risk of thread seizure by removing locking nut to cooler end of barrel.



REPLACEMENT TIPS

* FITTED AS STANDARD



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JMS197

"With my HP CAD sail a boat that

Ask Ben Lexcen what his most valuable design tool is and he'll tell you it's his Hewlett-Packard Computer Aided Design system. Here he talks about his experience with the HP system and offers some salient advice to the new generation of designers who will follow in his wake.

Have you always felt at ease working with computers?

"No way! Really I was a latecomer to computers because I didn't have any formal training and I was frightened of them. In fact, I used to dream up some wonderful excuses to avoid getting involved with them.

"But, of course, I realise now that if you're going to be a leader in any field, not just design, you've got to utilise the leading technology. And really this HP stuff is so easy to use, I'm not sure what I was frightened of."

Which parts of a boat do you design with the help of the computer?

"Virtually the whole lot, with the exception of tiny mechanical things. But we use it to design the shape and structure of the boat, and the sails.

"We use it to do all the hydro-dynamic considerations such as the total drag of the hull unit. Plus we use the computer to test different hull shapes."

What aspect of your involvement with Hewlett-Packard strikes you as being particularly beneficial?

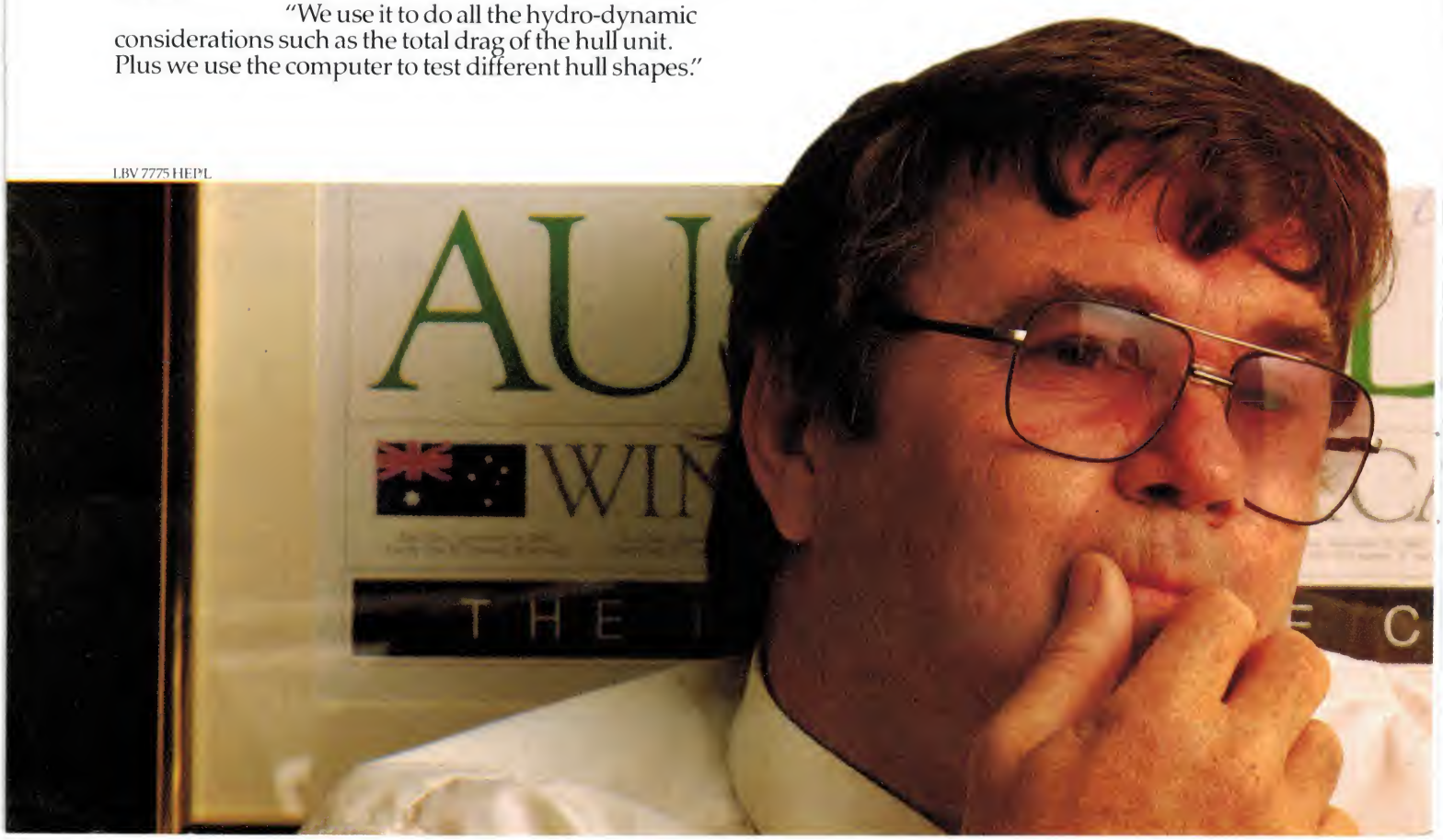
"Well, once you become involved with HP, you'll soon realise that apart from their technical excellence and innovation, one of their major strengths is that they have the people to help you get the best results from CAD.

"Because HP supply the hardware and the software, you've got a terrific advantage over the guy who tries to work with a lot of different suppliers. I mean it counts for a lot when the person who writes the software understands the workings of the processor.

"If you've got questions or problems, you can get answers and solutions from the one place. And believe me, that can save a lot of time and worry."

How has the HP equipment assisted in the day-to-day running of your office?

"Well, it's staggering how much faster we can get things done since we plugged into HP. This is mainly due to the fact that the computer does so much of the calculation which we used to labour over manually.



system I can virtually doesn't exist."

"For instance, now I can create the basic shape of a boat in a matter of hours whereas it used to take about a month. It might take me about ten minutes to do a keel whereas before it might have taken a week."

Does saving so much time mean that you have to compromise on quality or accuracy?

"Absolutely not. The equipment is dead accurate and I can do a more thorough job for far fewer man-hours.

"In fact, we are so confident in the HP equipment that when we've settled on the design of the boat to defend the America's Cup, we won't tank test it in Holland, we'll test it here in the computer. And when you're talking about a million dollar boat, you've got to be damn sure you've got the right equipment to do it."

What of CAD in the future?

"Look – I'm sure that if Australian designers don't grab CAD with both hands and run with it, the rest of the world will pass us by. And once we all realise its potential, you're going to see a lot of very happy and satisfied people in all sorts of design offices."

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Our Computer Aided Design solutions work together in an integrated design environment called the HP DesignCentre. HP's renowned technical excellence shines brilliantly in the DesignCentre where our engineering workstations and quality graphics peripherals come to the fore. And it's well worth remembering that HP's reputation for unfailing backup and support has been well earned.

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JVC's Compu Link Hi-Fi system allows you to operate every audio and video function without leaving the comfort of your lounge chair.

You can switch inputs, select tracks, adjust the volume and even change the frequency band of the graphic equaliser with a hand-held infra-red remote control unit.

It sends commands to the computerised remote controller with graphic equaliser through which every other video and audio component is co-ordinated.

The amplifier, AM/FM tuner, double cassette deck and compact disc player are more than capable of standing on their own. Each one holds pride of place in the JVC Hi-Fi range.

COMPU LINK
Remote
Control System

The remote Compu Link controller also has 3 video inputs, so your TV and video links up with your stereo to make a fully integrated home entertainment system.

Phone toll-free 008 22 5044 or Sydney 750 3777 for a complete information package. Or see any JVC dealer.

JVC
INVEST IN QUALITY

To fully appreciate it, ask for a chair, put your feet up and make yourself at home.

Hagemeyer (Australasia) B.V: Marketers of JVC products in Australia.

JVC 55 Forbes Macfie Hansen

ETI READER SERVICE 5

Comms equipment to lead $600m export

A 10-year strategy to develop Australia's communications equipment industry into a $600 million export earner was unveiled recently by the Federal Government.

The strategy is prompted by the enormous growth of the communications industry worldwide and its apparent stimulation of other industry sectors.

The main thrust of the strategy is to promote closer co-ordination between government and industry, and to look at the establishment of various, agencies (private and public) to assist in R&D in Australia (with the help of universities), in dissemination of information on business opportunities, and to assist in marketing equipment overseas.

This will take concrete form in $400,000 from the Government this financial year to assist in development of the industry's technological infra-structure and to meet costs associated with the implementation and further development of the strategy.

Senator Button also promised that the Government would examine the question of further direct financial support for communications equipment product development. This follows the review of Government high-technology purchasing arrangements recently announced by the Prime Minister.

Announcement of the Government strategy is a result six months of detailed discussion and consultation with interested groups including several industry associations, a combined trade unions group, Telecom, OTC, Government departments and the Government's tripartite advisory council on the electrical and electronic industries.

Last October the Industries Assistance Commission (IAC) recommended reduced tariff protection to the industry. In accepting the IAC suggestions, the Government agreed to gradually 'phase in' the reductions on condition that industry groups worked with the Government to develop a positive long-term industry growth strategy. Tariffs are now being reduced on most telecommunications imports from 30 per cent to 20 per cent over four years.

Senator Button praised the groups involved in consultations for their highly constructive contribution over the past year.

"I am confident that by the end of the decade — with contributing goodwill and commitment — we will have a more competitive, outward-looking industry sector playing a substantial role in world markets and in the broader development of Australia's industrial strength."

Chief among the industry's problems were the small size of Australian firms by international standards, leading to a weakened ability to tackle major contracts overseas, and a high level of foreign ownership.

"Six of the seven largest Australian communications equipment suppliers are foreign-owned," Senator Button said. "I don't believe foreign ownership is necessarily a problem. In fact, these international firms have made important contributions to the development of the Australian industry.

"It is important for overseas-based companies to appreciate that in the future it will become increasingly important to demonstrate real commitment to developing their Australian operations as a base for research and development and marketing beyond our shores — particularly in the Asia/Pacific region.

"Those international companies which can do this will be on the most secure footing to survive and prosper in this country into the next century.

"In other words, Australia will expect its relationship with overseas-based electronics firms to be more of a 'two way street' than it has sometimes been in the past.

"Government commitments will increasingly tend to favour those companies which make a serious commitment to this country as a base of operations beyond just its role as a protected marketplace."

The Minister cited a current approach by the Swedish-based firm, LM Ericsson, to seek a major Indonesian communications contract in cooperation with Telecom Australia.

"We will be investigating further ways by which the Government can encourage such initiatives.

"Beyond that, we wish to see some of the growing band of successful indigenous companies continue to gather strength, and to cooperate both among themselves and with large international companies where appropriate, to achieve export success.

"The industry's assessment of export prospects indicates that exports of $600-800 million can be achieved by the Australian industry by 1996, if all parties involved work seriously towards that goal.

"The goal is expressed in current values, and is based on a conservative interpretation of the industry's own assessment of its capability. So our actual performance could exceed the target set, and I have every hope that Australian enterprise will do so."

Senator Button said the strategy developed for the communications equipment industry would form a major part of an overall 'information industries' statement now under development. The statement will provide a broad framework for the Government's approach to several related industry sectors including the computer industry.

Schoolboy beats experts

A British schoolboy has taken just 10 days to solve a computer problem that has baffled an American hospital team for 25 years.

Using his family's computer, 16-year-old Christopher Crowhurst from Ivybridge, near Plymouth in south western England, discovered an error in the computer program being used by the Johns Hopkins Teaching Hospital in Baltimore.

Dr Peter Schilder, who heads the American team, was delighted with the speedy results and has invited the Ivybridge Community College pupil to spend July in Baltimore explaining the Ocular Tonographic Blood Flow Analyser Program and adapting it from his BBC Micro computer to theirs. He has been given £650 to fund the trip.

A friend of Christopher's father asked him to look at the program after hearing about Dr Schilder's problem. After a preliminary telephone conversation and some written details he came up with the answer. Final checks are being carried out at the moment, although Christopher says the program is ready to be used on patients.

Specialists believe that within a short time any doctor with a small personal computer equipped with the program will be able to spot potential heart attack victims within seconds. The tonograph is fitted to the eye to obtain a blood pressure reading. This and other important information is transferred to a computer and has until now had to go through a number of different stages.

"I don't really like computers," says Christopher. "I used to play space invaders, but it got boring."

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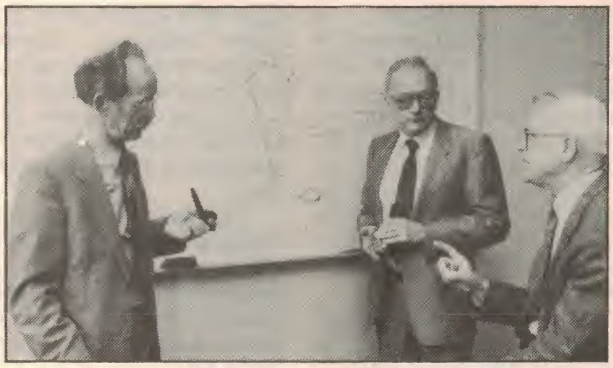


The three players discussing optical recording techniques.

Rank awards
The Rank Award has been won by three Philips researchers who laid the groundwork for optical recording during the 1970s. Dr P. Kramer, G. Bouwhuis and K. Compaan were presented with awards in June. The Rank fund was established in 1972 in the will of Lord Rank, the British film czar.

Opening
Schlumberger has underlined its commitment to Australia by opening a 7500 sq foot factory in June. Schlumberger manufactures factory automation equipment.

Duplicator
Eldorelt has purchased Regency Recordings, the big tape duplication service. Regency will be offering high speed loop bins, cassette to cassette and real time duplication, and intends to increase output from 1000 to 1500 cassettes a day this year.

Minerva users
A directory of OTC electronic mail service, Minerva, is being published by Modem Technology. The "Communique" will contain features as well as a comprehensive listing of Australia and NZ.

Joint venture
ACI Computers and Datec are joining forces to provide electronic services to the banking and finance industries. ACI has a high speed data network, Datec switch facilities, and banking software.

AWA
Warren Rose has been appointed general manager of AWA Rediffusion. He was formerly with Electrical Equipment. Peter Nicholson has become group General Manager.

Netmap
Netmap has appointed Warren Blood as National Sales Manager. He comes from Prime Computers.

Plessey
Dr Edwin J. Matiuk has been appointed a new Regional Manager for Australia and NZ. Matiuk succeeds the present incumbent, Mr Bruce Goddard.

Anitech
Grant Fisher has been appointed National Marketing Manager of Anitech's Instrument Division. Previously he was with Standard Communications.

Kakadu experts

Expert systems, first developed in the US in the 1970s, have now found an application in the Kakadu World Heritage Area in the Northern Territory.

The CSIRO, with the support of the Australian National Parks and Wildlife Service, has developed FIRES (Fire Expert System), to handle the complex task of fire management of Kakadu.

According to Dr Richard Davis, of CSIRO's Division of Water and Land Resources in Canberra, the system is "just what the doctor ordered", because it preserves the genuine expertise built up in the community through years of careful observation, without requiring numbers to pick up every statement.

"The information on the system doesn't disappear when the owner dies, just because he or she never wrote a book about it," he says.

"For land management on the grand scale called for by the 20,000 square kilometres of Kakadu, the expert system provides a way of methodically recording what individuals have seen and learnt about the region.

"A major obstacle to using computers for the task has been that the information available is not always quantifiable.

"Computers usually depend on hard data in number form, but expert systems provide a way out. They deal with statements as well as numbers, which is ideal for many land management operations."

A typical 'conversation' with FIRES might go as follows:
Ranger: 'G'day.'
FIRES: 'G'day.'
Ranger: 'We're in the hot season, what do you reckon a scorch height would be if a fire broke out here today?
FIRES: 'Where are you?'
Ranger: 'In the Kay 1 land system.'
FIRES: 'What's the wind strength?'
Ranger: 'Moderate.'
FIRES: 'What's the fuel load

Instrument maker consolidates

University Graham Instruments has announced the acquisition of Paton Electrical in a move which will strengthen its position as one of Australia's leading electrical equipment manufacturers.

Patons and University Graham are two of the oldest companies operating in the field and each has occupied a significant position in the marketplace for electrical testing, measuring and indicating instruments.

Executive Chairman of University Graham Instruments, Mr Jack Rutherford, said the takeover will lift overall sales of the company to more than $7 million in 1986.

"Considering the problems facing the Australian manufacturing industry, we believe this move indicates our confidence in the economy and our commitment to strengthening our position in this specialised high technology field," he said.

"This acquisition will help revitalise the electrical instrument manufacturing industry in Australia and introduce a scale of manufacture that will be more effective in the Australian marketplace."

Established in the 1930s, both companies manufacture and import electrical testing, measuring and indicating instruments for the Australian market. Products include panel meters, relays, temperature controllers, educational instruments, electronic control meters, current transformers, multimeters and special instruments.

Paton also has an arrangement with the CSIRO to undertake research and development which should lead to a new range of instrumentation.

The workforce at University Graham Instruments will grow to more than 70 people with the takeover. All those currently employed by Paton will be retained.

Some of the 20,000 sq km of Kakadu.

like?'
Ranger: 'That's moderate too.'
FIRES: 'Right. A bushfire now will probably burn with flames 2-3 metres high and scorch the vegetation 10-12 metres high. The main tree species affected will be Eucalyptus Tetrodonta and Eucalyptus Miniata'.

The first attempt at an expert system was with medical diagnosis in the US during the 1970s, when the combined medical knowledge of many specialists was incorporated into a system called MYCIN. Although only experimental, MYCIN inspired a range of expert systems now functioning in the USA.

In Australia interest is growing fast, and there are now several systems in operation, ranging from medical sample analysis at the Garvan Institute at St Vincent's Hospital in Sydney to the design of window frames at CSIRO's Division of Building Research in Melbourne.

FIRES provides the most convincing demonstration to date of the potential of expert systems as a powerful tool for land management.

The decision to build a trial expert system came after discussions between Dr Davis and CSIRO researchers Dr Joe Walker and Dr Ken Myers who were attempting to construct an 'ecological framework' for land management at Kakadu.

Information was gained from the knowledge and observation of rangers, from experiments run in Kakadu by Mr Jamie Hoare of the CSIRO Division of Forest Research in Canberra, and from work carried out in similar areas of Australia.

Vegetation type, the kind and amount of fuel they produce, and a range of meteorological data were also recorded. This information was then arranged according to the Aboriginal calendar. The 'knock-em-down storms' season, for example, occurs at the end of the monsoon, with storms capable of flattening the three metre high tropical grass. The seasons following are 'cool', 'cold', 'hot', 'early storms', before the monsoon arrives again.

Drawing on Mr Hoare's experience in Kakadu, 120 rules on fire behaviour were built into FIRES. All rules were expressed in plain English. A computerised thinking mechanism, known as an inference engine or 'shell', was then written.

"A computer loaded with this sort of information and wearing the right sort of thinking cap can come up with decisions identical to those made by experts," said Dr Davis. "It can literally draw its own conclusions.

"The sheer extent and variety of Australia's water and land resources continue to make it difficult and expensive to collect basic scientific data for land managers to use."

"Expert systems provide an opportunity to make good use of the information we have."

Were you there?

The London Electronics College, which celebrates its 80th anniversary this year, intends to mark the event by setting out on an international quest to find its oldest former student.

The College, formerly known as the British School of Telegraphy (founded 1906), trained early Marine Radio Officers using the original Marconi wireless telegraph. Some 300 of its students were at sea in 1912. Harold Bride, wireless operator on the Titanic at the time of the tragic iceberg disaster, and Thomas Cottam on the Carpathia, the first ship to acknowledge radio distress messages which saved so many lives, were both trained at the College.

Nowadays, the College specialises in professional electronics technician education, having ceased radio officer training in 1980.

In honour of the College's birthday, a general signal "QSO" is being sent out to all former students asking them to get in touch again. It's just possible that some of those original 1906 Marconi wireless telegraph operators will respond.

Present-day staff and students would be delighted to welcome such visitors on a tour of inspection — just to see how much electronics has changed in the era of microcomputers and new technology.

For further information contact **M. Spalding, London Electronics College, 20 Penywern Rd, London, SW5 9SU. Phone UK (01) 373-8721.**

NOTES & ERRATA

Current feedback for drill control, Ideas for Experimenters, August, 1986: Beware: the earth and neutral labels were transposed on the circuit diagram we published. Earth is actually the lead connected to the case with the ground symbol attached. Neutral is the one above.

Rocky winner

Mrs Dumbrell receiving her keys from Rod Bragg, Daihatsu.

Mrs Laurel Dumbrell, a Carss Park (Sydney) housewife who also teaches writing to adults as a part time occupation with the Arts Council, was the lucky winner of a Daihatsu Rocky in a recent computerised draw which involved over 19,000 subscribers to Federal Publishing magazines.

"Rocky couldn't have come along at a better time," said a delighted Mrs Dumbrell.

"My husband and I have been renovating an old farmhouse on some land in the Kurrajong Hills and we badly needed a four wheel drive vehicle but couldn't afford one."

"I still can't believe our fortune — it's a tremendous thrill."

KILOHERTZ COMMENT

AUSTRALIA: The Australian Broadcasting Corporation's three 50 kW transmitters servicing the Northern Territory have been noted at times on extended use of some frequencies. At 1100 UTC the 120 metre band is used with Alice Springs 2310 kHz, Tennant Creek 2325 kHz and Katherine 2485 kHz. Alice Springs has been noted on daytime channel, 4835 kHz, to past 0930 UTC at times. The program included an ABC News Comment at 0900 UTC, at 0910 a report from Darwin of news from the Northern Territory and on Monday at 0915 UTC a program schedule for the week in English and in the Aboriginal language. The frequency provides good reception, though Radio Reloj, Costa Rica on 4832 kHz causes some sideband interference.

AUSTRIA: Austrian Radio in its transmission to Australia, has made a frequency change and is now using 9585 kHz replacing 9735 kHz. This transmission is for broadcast between 0600 and 0700 UTC, with the first 30 minutes in German; English is broadcast between 0630 and 0700 UTC.

BANGLADESH: Radio Bangladesh is using the new frequency of 7505 kHz for its English program 1815-1915 UTC. News at slow speed is broadcast at 1900 UTC but from this time interference is noted from Radio Beijing. The alternative frequency of 6240 kHz carries the same program.

ECUADOR: HCJB Quito Ecuador has extended its English Service to Australia to 1130 UTC. The transmission is now 0700-1130 UTC on 6130 kHz, 9745 UTC and 11925 kHz. "DX Party Line" which was formerly broadcast three times a week, has been reduced to a Monday and Saturday broadcast, at 0930 UTC.

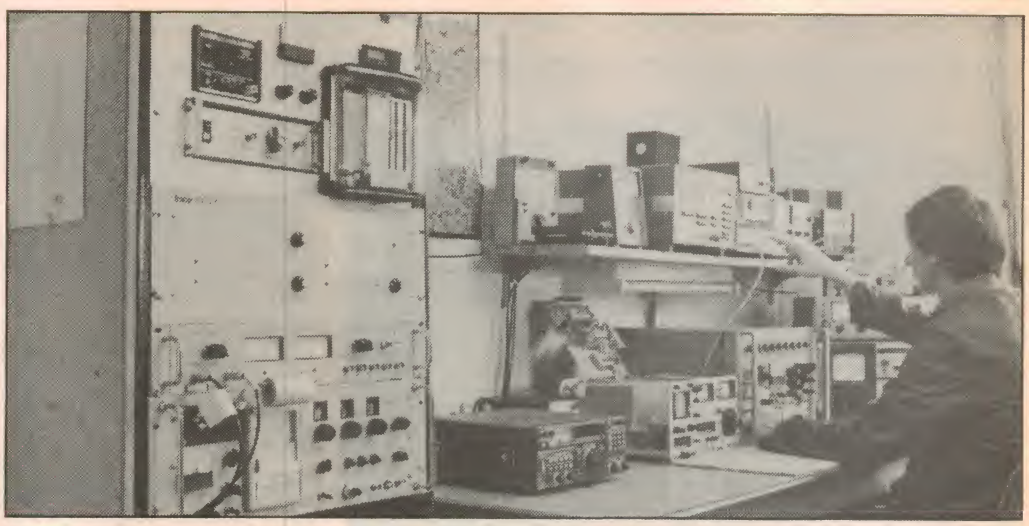
GUAM: KTWR Trans World Radio, is now on 11735 kHz with English 0745-0900 UTC Monday to Friday and on Saturday and Sunday the broadcast opens at 0730 UTC. "Distant Listeners Log" on Saturday is now heard at 0828 UTC.

MONGOLIA: Radio Ulan Bator has provided details on its latest schedule and English broadcasts are 1200-1235 UTC and 1445-1520 UTC on 9615 kHz and 12015 kHz, while two other English transmissions are broadcast 1255-1330 UTC and 1940-2015 UTC on 7235 kHz and 1530 kHz.

PHILIPPINES: The Far East Broadcasting Company, Manila has moved to 11885 kHz for a transmission in English 0830-0930 UTC. This frequency replaces 11890 kHz and later 11850 kHz, but the new 11885 kHz is also prone to jamming on that channel. An alternative frequency of 15350 kHz carries the same program but suffers interference from Radio Moscow.

TURKEY: Ankara is using 17725 kHz for its broadcast to South East Asia in English from 2000-2050 UTC, 2200-2250 UTC and 0300-0350 UTC. The first two transmissions are also heard on 7210 kHz, 9535 kHz and 9560 kHz, while the 0300 UTC broadcast is carried on 9560 kHz.

This item was contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times quoted are UTC (GMT) which is 10 hours behind Australian Eastern Standard Time.



CONSUMERS WARNED ABOUT STEREO RADIOS

Misleading labelling of radio receivers has led several State Consumer Affairs Departments to issue warnings to consumers and refer matters to the Trade Practices Commission.

Only 65 radio receiver models can currently claim (in labelling and advertising) to be truly "AM/FM Stereo" or "Stereo AM/FM", since only those 65 radios have stereo capacity on both AM and FM bands, according to Stereo AM Australia, a national body of AM radio operators. However, many receivers in shops are labelled and promoted as "AM/FM Stereo" while in fact they only have a FM stereo and AM mono capacity.

"Under Section 52 of the *Trades Practices Act* many retailers and manufacturers could be, perhaps unwittingly, giving the public misleading and deceptive information on radio receiver units," says Chris Brammall, Chairman of Stereo AM Australia.

"We've had numerous complaints from listeners on this issue. And until the Trade Practices Commission addresses the question, our advice to consumers is to be very careful when they buy a new radio," added Mr Brammall.

"If you want stereo on both bands, try the product first to make sure."

ACL certified

Associated Calibration Laboratories, Melbourne, recently obtained certification as a National Association of Testing Authorities (NATA) approved laboratory for frequency measurement. This is in addition to its NATA certification in various areas of acoustic calibration and surveys.

A unique feature of the frequency reference system is that it is phase-locked to Omega VLF transmissions which have an accuracy of 1 part in 10^{12}.

Allowing for measurement uncertainties, the laboratory can certify frequency standards to better than two parts in 10^{10} and can measure nonstandard frequencies from 10 Hz to 1 GHz.

ACL is situated at **27 Rosella Street, Doncaster East, 3109. (03) 842-8822.**

Real estate TV

The Victorian Real Estate industry is about to enter the communications revolution with a link-up to a new nationwide television network called channel 3 — the real estate channel.

Corporate Data Services, a Melbourne-based communications group has been granted special licences to operate this unique UHF television frequency service in Brisbane, Sydney and Melbourne.

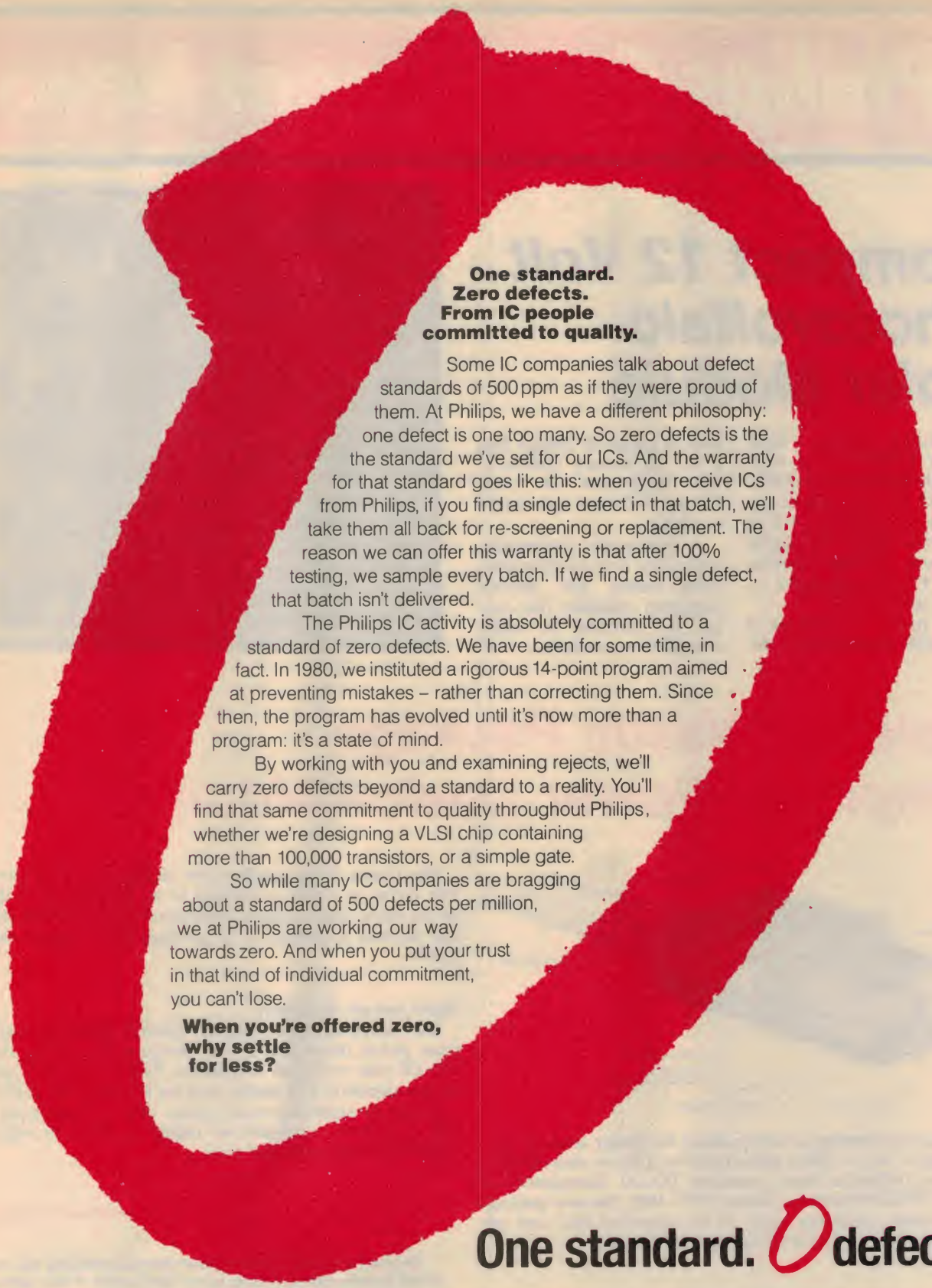
The real estate channel has now begun transmission in Melbourne and plans to broadcast in Brisbane and Sydney.

Transmissions will be received by participating real estate agencies, offices of property investors such as banks, stock brokers, international hotel rooms, legal firms and public areas such as shopping centres and malls. The television sets in these areas are equipped with a downconverter with output on channel 3, and a small indoor or rooftop antenna.

The basic service offered by the real estate channel is a video catalogue of homes for sale, auction or lease. The telecast video sections guide the viewer through a home, business commercial building, tourist development, farm or other property. The various properties are categorized according to type, location, and agent (if desired), giving the buyer access to a wide range of properties or immediate appraisal of a type of property in a particular area of Australia.

Besides the catalogues of investments the real estate channel can also use its Australia-wide network for televised auctions.

In a city-wide auction, receiver units could be installed in every potential bidder's home or office. For interstate or overseas live coverage the real estate channel will make use of Aussat to deliver the auction live to any range of bidders.



One standard.
Zero defects.
From IC people
committed to quality.

Some IC companies talk about defect standards of 500 ppm as if they were proud of them. At Philips, we have a different philosophy: one defect is one too many. So zero defects is the the standard we've set for our ICs. And the warranty for that standard goes like this: when you receive ICs from Philips, if you find a single defect in that batch, we'll take them all back for re-screening or replacement. The reason we can offer this warranty is that after 100% testing, we sample every batch. If we find a single defect, that batch isn't delivered.

The Philips IC activity is absolutely committed to a standard of zero defects. We have been for some time, in fact. In 1980, we instituted a rigorous 14-point program aimed at preventing mistakes – rather than correcting them. Since then, the program has evolved until it's now more than a program: it's a state of mind.

By working with you and examining rejects, we'll carry zero defects beyond a standard to a reality. You'll find that same commitment to quality throughout Philips, whether we're designing a VLSI chip containing more than 100,000 transistors, or a simple gate.

So while many IC companies are bragging about a standard of 500 defects per million, we at Philips are working our way towards zero. And when you put your trust in that kind of individual commitment, you can't lose.

When you're offered zero, why settle for less?

One standard. 0 defects.

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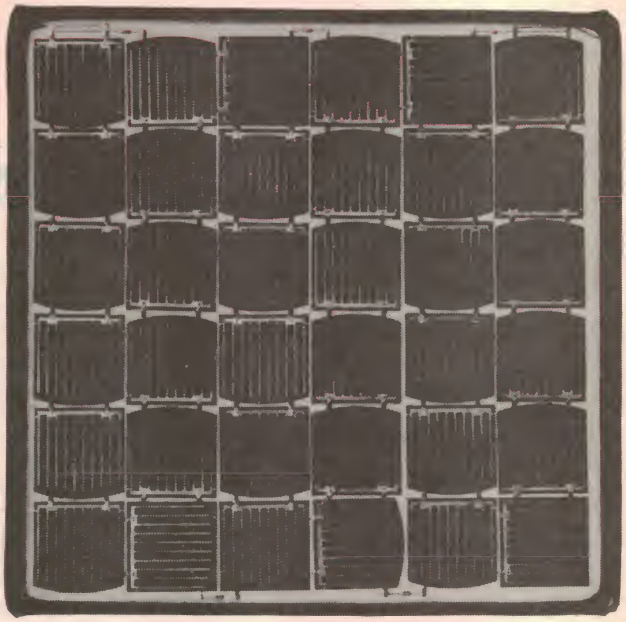
PHILIPS Electronic Components and Materials

PHILIPS

Philips Component News
No 5 Sept 1986

Compact 12 Volt Photovoltaic Solar Module

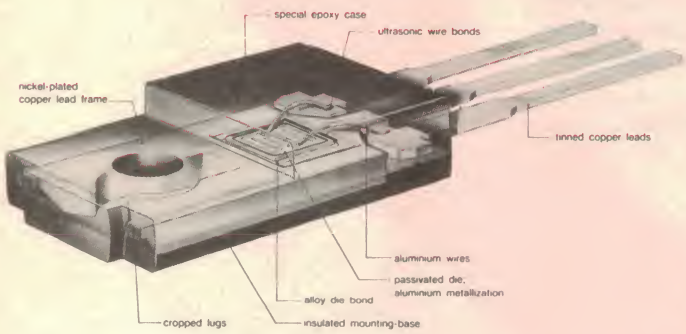


Australian made Solar Module ESS3601 is a compact lightweight solar module intended for low power requirements including: • Battery trickle charge • Logging equipment • Small electric fences • Small appliances — radios, cassettes, etc.

The panel is rated at 4 watts peak power and will deliver in excess of 250mA into a 12 volt battery (1Kw/m^2). The dimensions are only 220mm x 220mm and weight is 0.53kg.

A laminated construction with a low iron toughen glass front surface will provide long term reliability that cannot be matched by many other low cost modules. □

Isolated Plastic Package Simplifies Power Device Mounting



We are introducing a new package for power semi-conductor devices which offers manufacturers a more cost-effective mounting technique than a standard TO-220. Designated the F-pack TO-220 (envelope number SOT-186), the new package has a plastic insulation layer on its mounting base and tab thereby making insulated mounting much simpler.

Direct mounting

The SOT-186 can be mounted directly onto a heat sink, using the same screw or clip as the standard TO-220, without any extra insulating components such as mica insulators, heat sinking compound and insulating washers. As well as cutting component costs the F-pack also significantly reduces assembly time.

The F-pack is the result of new techniques which allow very thin layers of plastic (±0.3mm) to be moulded onto the rear of the metal comb without significantly affecting the electrical and thermal properties. It is specified for a voltage rating of 1100V.

Better free air dissipation

Safe operating area, transient thermal resistance and maximum power dissipation are all comparable with the standard TO-220 plus insulation accessories. Free air power dissipation is approximately 17% better than for the standard TO-220.

Currently eight important power device families are available in F-pack; eventually we intend to offer our entire TO-220 product range also in F-pack. □

Cut-away view of a SOT-186 power transistor showing the constructional features that contribute to the high quality of these devices. An essential part of the design is an epoxy insulating layer formed under the lead frame during encapsulation. Less than 400μm thick, the layer has a breakdown voltage in excess of 1000V and its thickness is controlled to within 25μm for consistent thermal and electrical properties.

We make electronics in Australia

Highly-integrated CMOS microprocessor combines cost-effective with powerful performance

Reinforcing our position as a leading high-tech innovator, we are introducing the SCC68070, a highly-integrated 16 bit microprocessor which contains central-processing unit (CPU), memory-management unit (MMU), direct-memory access (DMA) control, I^2C bus interface, RS232C interface, and three counter/timers all on the same chip. Fully software-compatible with the popular 68000 family, this is the first microprocessor to feature MMU and DMA functions together on the same chip. The low power 10MHz device is fabricated in our C400 CHMOS process.

Immediate cost reductions

The SCC68070 permits designers to achieve immediate cost reductions in developing newer versions of existing 68000-based systems and will also lead to new designs that can exploit its unique, integrated functional advantages. Particular applications are CAD workstations, telecommunications equipment, and the latest home and personal computers. Systems built using the new SCC68070 will provide comparable performance to the 68000 but with fewer components, lower power requirements and reduced cost. The SCC68070 comes in an 84 pin plastic leaded-chip carrier bringing all the benefits of surface mounting.

The CPU has a 68000-compatible instruction set and a 16 Mbyte addressing range plus vectored and auto-vectored interrupts with seven levels of interrupt priority. Further, the SCC68070 has an on-chip bus with additional registers to control its added functions. Enhanced bus-error handling similar to that of the 68010 and on-chip bus arbitration and control circuitry ensure that the parallel system bus is managed well and performance remains high.

Consumer and professional

The SCC68070 is the culmination of a process involving the analysis of market-needs information, the development of a product-requirements model, and a zero-defects quality environment. Because the new microprocessor is designed based upon needs that cross consumer-and-professional-system boundaries, it will be marketed to developers of systems in both market areas, worldwide.

Some previous microprocessors have on-chip memory management for high-performance, multi-tasking systems. Others, aimed to lower-cost systems, feature several peripheral functions integrated alongside the central processing unit. The SCC68070 has both.

The chip has approximately 1,000,000 transistors and is built using 2-micron design rules. Despite its complex circuitry and speed, the SCC68070 will consume only about one watt of power. It is therefore attractive for portable systems using battery power and for systems requiring dense packaging with reduced cooling requirements.

Prototyping/Samples

Samples of the SCC68070WP are expected to become available late in 3rd quarter 1986, at less than A$200 each. An evaluation board is under consideration.

Documentation

Already available is a users manual for hardware implementation, at $50 from Elcoma. A software manual, applications notes, and ECA article will appear in second half 1986. (ECA = Electronic Components and Applications, an excellent quarterly technical journal available from Elcoma on subscription).

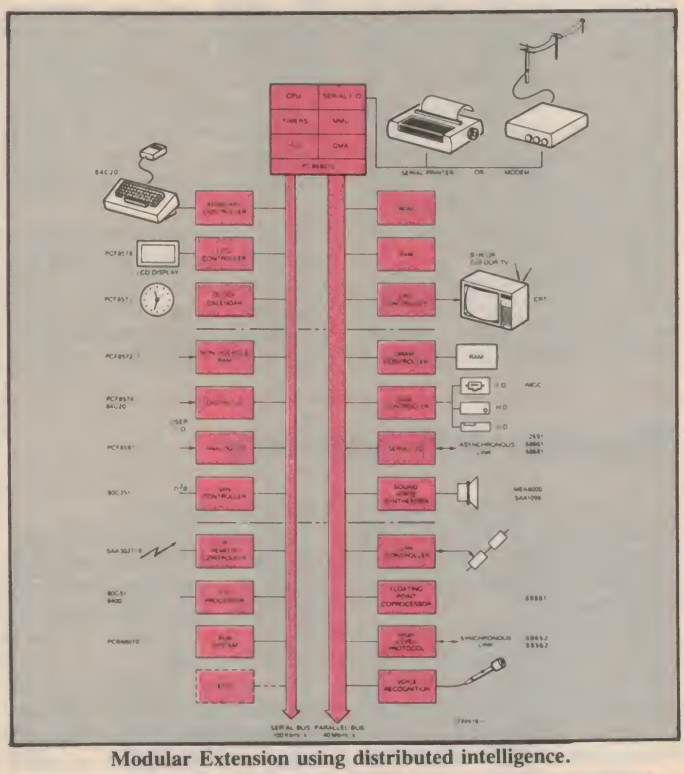
Support

Developing applications for the SCC68070 requires the same tools already available for supporting the 68000. There are a variety of development systems plus cross-software products for software development in a Digital Equipment Corporation VAX environment. In addition, we will offer support software and simulation tools for the SCC68070. □

"Electronic Component and Applications" (ECA) is a 64-page, full colour magazine which contains articles on important new Philips components and their applications.

ECA is issued by Philips Electronic Components and Materials Division (Elcoma), which embraces a worldwide group of companies with sales and manufacturing facilities in every major component market.

The latest issue is completely devoted to the Philips extensive HCMOS range. The subscription for this quarterly magazine is $25.00 a year. Send now for more information. □



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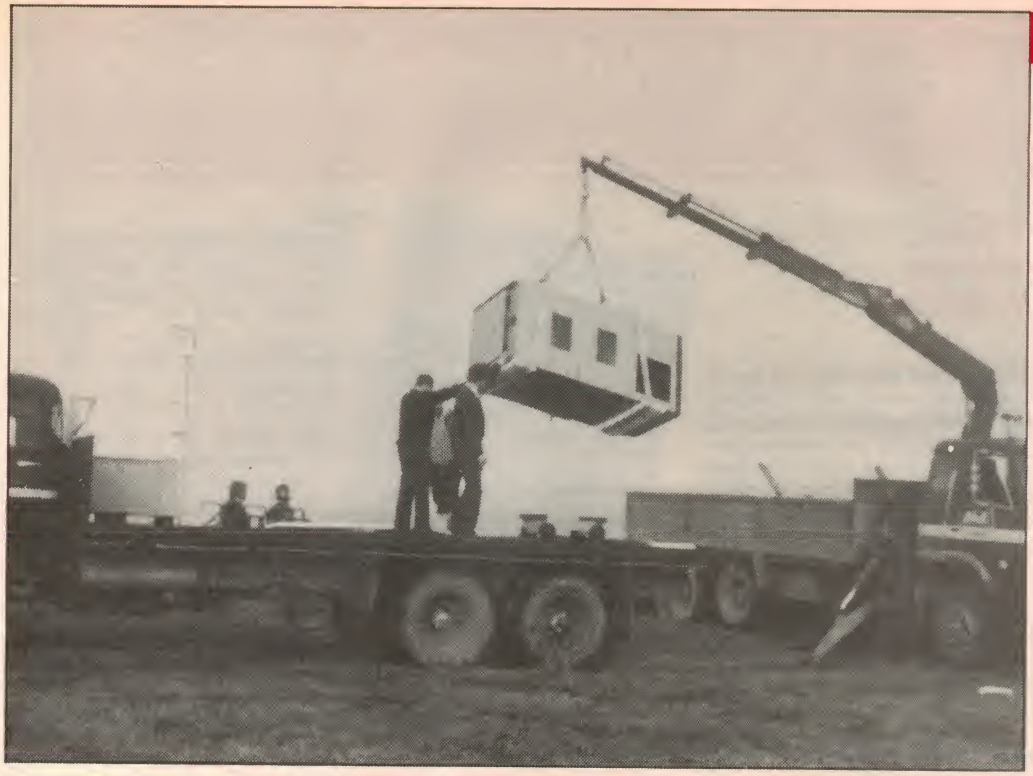


Back on full power

Recently (ETI, Dec 85), I reported on the destruction of the transmitter building of Radio 4XD in New Zealand by an arsonist which put the station off the air. The transmitter building is located at Highcliff overlooking the city of Dunedin, along with other aerial towers belonging to Radio New Zealand and Radio Otago 4XO.

The Broadcasting Corporation of New Zealand (BCNZ) was quick to supply a mobile transmitter which was hooked to the tower and transmissions resumed in a matter of a few days of the fire. A new concrete block transmitter building has been completed and will house two surplus BCNZ 2 kW AWA transmitters, one for regular operation and the other standby.

The broadcasts of 4XD Dunedin Radio are unique in that the station has been operating since 1922 and is one of the oldest broadcasters in the British Commonwealth. It's also different from most radio stations as it is a non-commercial operation staffed by volunteers.

Dunedin Radio 4XD operates on 1305 kHz. As there is no other station using this frequency in either Australia or New Zealand, its signals are well received on the East Coast of Australia and in the South Pacific. The mailing address is Dunedin Radio 4XD, PO Box 404, Dunedin. Broadcasts are 0600-1100 UTC daily with an earlier sign-on on Saturday at 2100 UTC.

— Arthur Cushen

Stereo AM survey

Consumers are prepared to pay a premium to hear both AM and FM radio in stereo, according to a McNair-Anderson survey recently released.

The survey, which was commissioned by Stereo AM Australia (a committee representing AM radio stations broadcasting in stereo), shows that 70% of Australians would prefer to buy a car fitted with both AM and FM radio bands in stereo. More importantly, the survey, which was based upon a national sample of 1312 people, shows that over a third of the population would pay an extra $100 or more for a hi-fi system with both AM and FM in stereo.

Just under 50% of the sample said they would pay an extra $40 or more for a new car radio with both AM and FM bands in stereo, as opposed to AM mono/FM stereo.

The survey should be good news for both car and radio receiver manufacturers who are selling (or soon plan to sell) radio receivers with stereo on both AM and FM bands.

Stereo AM Australia reports that one year after the introduction of AM stereo over 55 different models of stereo AM receivers are available, and over 45 AM radio stations are broadcasting in stereo.

Commenting on the first birthday of AM stereo, Mr David Maxwell, chairman of Stereo AM Australia and General Manager of Sydney's Radio 2UE, said "stocks of stereo AM receivers are no longer limited and the range of model options for consumers is also increasing daily".

However, considerable pressure still exists for the Government to allow conversion of AM licences to FM. The Department of Communications has released a report on the issue, and expects to make a decision late this year.

R&D up

The Australian Bureau of Statistics has released preliminary results of the Survey on Expenditure on research and development (R&D) carried out by the business sector in 1984-85. They show an increase in expenditure of 43 per cent in constant prices, over the 1981-82 period when the last survey was carried out. Human resources devoted to R&D business enterprises increased by 36 per cent over the level for 1981-82.

In a joint statement the Minister for Industry, Technology and Commerce, Senator John Button, and the Minister for Science, Mr Barry Jones, said "The most encouraging aspect of the figures is that the private sector R&D expenditure has increased significantly over the three year period. We welcome the change in direction, after a period of decline in which Australian private sector R&D investment alone fell, of the 24 OECD nations. But we start from a very low base.

"The increases also reflect the growing recognition of the importance of R&D expenditure in improving the quality and desirability of Australian products, and the necessity that we look beyond our own coastline to seek markets in other countries.

"While this change in direction is pleasing, it should in no way be a signal for complacency by the business enterprise sector. In comparison with the other OECD countries, the level of R&D carried out by Australian business enterprises, is still much lower than the countries with which we compete. However, it does indicate that industry is beginning to head in the right direction.

"These results are consistent with the Government's expectations. Indications of expenditure by companies claiming the 150 per cent tax concessions for R&D are that there will be a further increase of 33 per cent in real terms this year and we expect additional increases in following years."

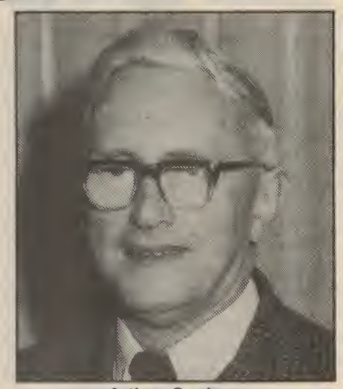
NZ voice on SW

New Zealand's only regular shortwave broadcaster, Arthur Cushen, and our shortwave feature writer, was guest speaker at an International Radio Convention in Montreal in July. Arthur Cushen broadcasts over the English Service of Radio Nederland on Pacific affairs.

Arthur's voice is known to millions around the world as his contribution on Radio Nederland is repeated 16 times throughout the day from transmitters in Holland, the Caribbean, and off the coast of East Africa. (Total output power of these transmitters is over 3 million watts.)

He is a frequent broadcaster from the BBC and within New Zealand, his 'Radio World' features are carried by Radio Rhema and 4XD Dunedin. During the period when Radio New Zealand broadcast a shortwave service, his 'DX World' program ran from 1960 through to May 1982.

The Montreal Convention was hosted by Radio Canada International and organised by the Association of North American Radio Clubs, an umbrella organisation of radio clubs. The Secretary General of a similar European organisation in the South Pacific Association along with Arthur was also present. It was the first time that the three umbrella organisations have discussed mutual problems about their leisure pastime.



Arthur Cushen

During the convention a meeting of frequency managers from the BBC, Voice of Germany, Voice of America, Radio Free Europe, Radio Liberty and many other organisations was held in Montreal to plan their frequency requirements for the forthcoming months.

Recently Arthur was guest on American Broadcasting Company's 'Coast to Coast Talkback Show', the Ray Briem Show. During this five hour program listeners from throughout North America phoned in for advice from experts who were in the KABS studios, Los Angeles. Additional information was available from Dr Richard Wood in Hawaii and from Arthur Cushen in Invercargill, New Zealand, who were linked to the program by telephone, giving a broader base to the network feature.

— Arthur Cushen

Bosch joins Philips

Bosch and Philips are founding a joint company for professional television equipment.

Robert Bosch of Stuttgart, Germany, and Philips Gloeilampenfabrieken of Eindhoven in The Netherlands, signed a contract last July, 1986, for worldwide cooperation in the field of professional television equipment in order to continue and extend their mutual activities in this field.

They have set up a company with the name BTS — Broadcast Television Systems with its head office in Darmstadt, in which Bosch has 70 per cent and Philips 30 per cent.

Bosch will integrate its Television Systems Division in Darmstadt and its Video Equipment Division in Salt Lake City, Utah, provided the American Federal Trade Commission gives its permission.

Philips will lose its development and manufacturing facilities in Breda, The Netherlands, and its sales company, Philips Television Systems in Mahwah, New Jersey.

For further information, contact **Bosch Electronic Products Division, Robert Bosch (Australia)** on **(02) 887-4099.**

Borland breakthrough

Borland International has released what it calls a 5th generation language development system called Turbo Prolog.

Borland says the system outperforms other existing Prolog language tools by factors of up to 10,000 with performance comparable to prototypes of the Japanese 5th generation computers. According to Borland President Philippe Kahn, the availability of powerful Turbo Prolog programming tools will spur the development of new more powerful expert systems, and customized knowledge bases.

There will be an acceleration in natural language front-end systems for vertical markets, and 'smart' information management systems. "Even prototyping of applications will be faster using Prolog," he said. "Most software today is quite primitive, and very little of it is designed to make efficient use of personal computers. We designed Turbo Prolog for the PC to make it perform consistently with large computer systems in terms of speed, throughput and performance," said Kahn.

Prolog was developed by Alain Colmerauer at the University of Marseilles, France, in the early 1970s, and designed for programming in logic. It is already being adopted by the business and industrial sectors, educational institutions, and research and engineering organisations around the world.

According to Kahn, widespread acceptance and use of Prolog will transform computer programming as we have known it for decades.

"Up until now, the computer programmer had to instruct the computer in solving a problem by providing a structured series of steps or procedures for the computer to follow. With Prolog, programmers need only describe facts, and let the computer determine the solution on its own. This takes the PC a step beyond its traditional computing functions of numerical calculations or data storage and retrieval. Prolog brings the capability to infer or derive information from stated facts," he said.

The Prolog language employs a theorem-proving algorithm for logic programming in order to take a set of premises and arrive at an appropriate conclusion. The algorithm utilizes pattern-matching and back-tracking — a true part of AI technology.

For further information contact **Arcom Pacific** on **(07) 52-9522.**

Telecom to help Oz manufacturers

Telecom has opened a Technical Liaison Office to provide Australian companies with technical information to assist in the development and manufacture of new telecommunications products.

Mr Bob McKinnon, Telecom's General Manager, Network Engineering, said "We want to encourage more Australian research and development. Not only do we need new products for our own network, we would also like to see Australians exporting the latest in telecommunications technology".

"Telecommunications technology is advancing rapidly and becoming more complex," Mr McKinnon said. "We need to help companies identify opportunities, be aware of relevant standards and specifications and have the chance to develop Telecom designs and industrial properties."

The Technical Liaison Office will be at Telecom's national headquarters at **3rd Floor, 172 William St, Melbourne. (03)606-5068 or (03)606-6806.**

New time code for VNG

An updating of the broadcast time code format has been implemented on the shortwave standard frequency and time signal broadcasting service, VNG, to add time of day and day number of the year information without alteration of the existing minute, 5-minute and 10-minute identifying sequences or DUT1 coding. The DUT1 code relates the deviation between the Earth's angular position time scale UT1 and the Coordinated Universal Time Scale UTC.

VNG has operated from Radio Lyndhurst, Victoria, for 20 years. Telecom Research Laboratories were responsible for the establishment of the service and continue to maintain the carrier frequencies and instant of time, as transmitted, to within close tolerances of the Telecom (ATC) Standard of Time and Frequency operated at the Clayton Laboratories complex.

The addition of this extra information in binary-coded decimal (BCD) form, will enable time code receivers to operate directly from the received signal by decoding the pulse sequences and updating a receiver's time output completely every minute.

For maximum security under marginal reception conditions, the so-called 'slow code' at a bit rate of 1 Hz has been adopted, the complete information thus extending over most of one minute. The low transmission rate also permits decoding by the use of simple recorders.

As VNG has Australia-wide coverage, the upgraded time service will have many new applications where HF radio reception is the only convenient source of accurate time information. Such applications include surveying, data logging, telemetry systems and shipping.

Hard disk drives too reliable

"The hard disk drive has become so reliable that users forget that it's even there and then *pow!* right out of nowhere glitch, a heavy handed user or an employee with an axe to grind erases a year's worth of data." So says Daneva Australia Marketing Manager, Max Pietruschka.

Max has seen the cost of hard disk drives drop to the point that the average PC isn't complete without one. "It isn't that they are being given away with every computer," he continued, "it's just that users no longer equate the value of their stored data with the value of the storage device. What price do you put on 20 Mbyte of data? I'm not only talking about re-entry man hours, some data is just not recoverable!".

Max sees an urgent need for education of the PC fraternity so that they really understand the limitations of hard disk integrity and take the necessary precautions to ensure their data's protection.

He pointed out that Daneva, alone, offers at least seven solutions to the backup and security problem. "For as little as $200 a PC user can backup 10 MB in eight minutes using Fastback, a floppy based archiving system. On an AT you could lay down 20 MB in the same time.

"Removable hard disk media, although just gaining acceptance, is an excellent method of having your hard disk and storing it too. At the moment there are about three standards of tape drive with the data cartridge being the most popular.

"The ultimate backup for high performance hard disks of 70 MB and above just has to be the laser disc. Prices for these drives are dropping rapidly as the industry discovers the advantage of having an incorruptible, transportable and rapid access medium on which to store their hard won data."

Image versus word processing

A report just released by International Resource Development, a US based consultancy group, says that image processing is now reaching such levels of sophistication that the traditional role of word processing is under threat.

The new phenomenon is called desk top publishing. This is taken to mean bringing the power of graphics functions and alphanumeric manipulation provided by the new breed of micros to bear on the paper that gets churned out of a million offices across the nation. The report looks at the convergence of a range of office technologies: the photocopier, fax machine, scanners, digitizers and so on. The latest trend is towards controlling these with a PC, thus integrating all their functions.

Central to this trend is the advance of PC technology. The possibilities in the area are displayed by the latest offering from Sublogic, the Illinois based company that developed Flight Simulator and Jet. It's called the IB-3DI and includes real time animation language (RTAL), a 3D editor, an animator, plotter and digitizer interface, a 3D database and demo program. The whole thing is designed for an IBM-PC fitted with Sublogic's X1 board.

Although the X1 board has a resolution of only 640 x 200, its powerful hardware and onboard software functions mean it can draw 7 million 4-bit pixels every second, and an even more impressive 100 million polygons every second, once again with 4-bit pixels.

The importance graphics and computer imaging are starting to assume can also be gauged from the growth of educational institutions offering graphics courses. The latest news we have is from Preston TAFE in Melbourne, which is starting a CAD concepts course. Significantly, the prerequisite for the course is in drafting, not in computer literacy.

Graphics is also making itself felt on the industrial front. Navatech controls ((02) 758-1122) has just released a colour graphics package called Screenware. It is intended for process control terminals such as are now commonly used in factories to control assembly lines.

The idea is that almost any IBM screen can be animated to make the operator interface more user friendly. Information can be conveyed more easily and operator errors, now a major problem, are reduced.

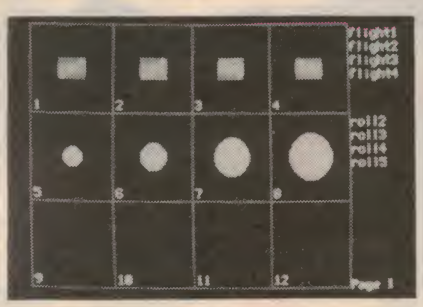
Of course, communications is fundamental to these trends, whether it be across a factory, across an office or indeed, across the state. But news that Telecom Australia has hiked prices on its Megalink local area lines has angered many in the computer industry. Austcad boss Chris Harris fired off an angry press release in which he described the new charges as untimely and unjustifiable.

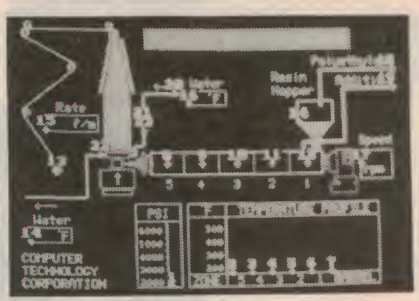
Megalink lines are used by Austcad to link its computer aided design facilities and terminals to clients in the manufacturing, engineering and architectural fields across the Sydney and Melbourne metropolitan areas. Austcad's major clients include Westpac Engineering, Tubemakers and Sydney County Council.

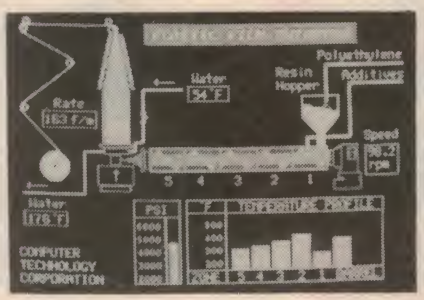
VIEW PROGRAM WITH ON-SCREEN MENU

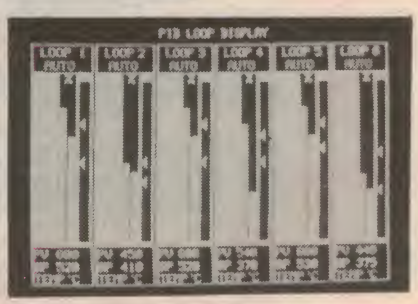
X-1 graphics board display

IBM colour/graphics adapter display









FREE POSTAGE FOR ALL ORDERS OVER $50!

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).
Features include:
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

Without timer Cat. X14950
Special, only $79.95

SCOPE 60W SOLDERING SYSTEM

- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side.
- Soft and cool hand grip in pliable rubber.
- Screw type connector prevents accidental plug removal and guarantees solid contacts.
- Temperature lock allows production supervisors to control soldering temperatures.
- Anti seize tip retention design reduces risk of thread seizure by removing locking nut to cooler end of barrel.
- Optional 30W soldering pencil is available for finer work.

Cat. T12900 **Normally $159**
NOW $149

POWERFULL MINI DRILL

Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit.
Requires 12V 1 AMP.(use with M19010)
Cat. T12302 ..... **$17.95**

TEXTOOL SOCKETS

P17016 16 pin **$14.50**
P17024 24 pin **$14.50**
P17028 28 pin **$19.50**
P17040 40 pin **$22.50**

NEW INTRA HIGH RESOLUTION RGB COLOUR MONITOR!

Size: 14 inch
Sync. Horiz. Scan Freq: 15.75 KHz
Sync. Vert. Scan Freq: 50 Hz
Band width: 18 MHz
Resolution: 640 x 400 dots
Display Format: 80 x 25 Characters
Display Colours: 16 colours.
Input Connector: 9 pin D type
Cat. X14520 ..... **only $695**

ARLEC SUPER TOOL

A versatile 12V electric tool for...
- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:
Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor. 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee

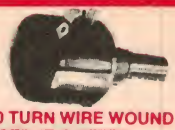
Contents:
- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
- 6 eraser sticks
- Instruction sheets

Cat. T12300 ..... **$49.95**

UHF TO VHF TUNEABLE DOWN CONVERTER

Suits all TV's and allows VHF sets to watch and listen to SBS Channel 28
- Has built in amplifier to ensure no signal loss.
- Tuneable UHF band 4/5 to VHF channel 1.
- Power supply 12V DC 100mA (included).
- Allows TV without UHF to recieve on-air UHF signal or use VCR, Video Game, Computer, etc.

Cat. L15021 **$99**



10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534
¼" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

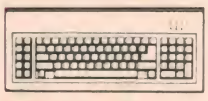
R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9 **$13.50** 10+ **$12.50**

PROGRAMMABLE 24 HOUR TIME SWITCH

- 48 switching possibilities per day
- 240V AC, 2400 watt, 10 amp
- Suitable for turning on...
  Heaters/Coolers
  pool filter
  electric blankets
  cooking appliances
  waking you, even making the coffee!
  lights etc for security while you're away from home!
- Bargain Price!

Cat. M22002 **only $19.95**

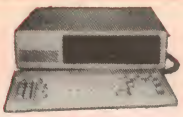


"IBM AT STYLE" KEYBOARD

- 100% IBM* PC, XT compatible.
- low profile keyboard design,
- proper placement of shift keys with large key tops to suit professional typists
- 3 step height/angle adjustment.
- Cherry brand TS-M0001 19mm low profile switches, meet 30mm ergonomic requirement, and provide high performance and maximum reliability.
- Curl lead plugs straight into IBM* PC/XT
- Status displays, (3)

Just like the "real McCoy" only at a fraction of the price!

Cat. X12020 ..... **Normally $245**
SPECIAL, ONLY $199



IBM* COMPATIBLES from $949*

Incredible deals to suit everyone including special package deals!
*256K RAM, single drive, graphics, disk controller and printer cards. **$949**

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. **only $1,395**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty. **only $1,495**

256K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer and a monochrome monitor and 3 months warranty! **only $1,995**

640K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer, a monochrome monitor and 3 months warranty! **only $2,095**

*IBM is a registered trademark

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$6.75	$5.95
2156 240V 6-15V 2A Cat. M12156	$9.50	$8.95
2851 240V 12-6V CT 150mA Cat. M12851	$4.50	$3.60
6672 240V 15-30V 1A tapped Cat. M16672	$9.95	$9.30
2860 240V 15V CT 250mA Cat. M12860	$4.95	$3.95

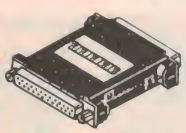
RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat. S15029 12V 1.2 AH **$12.95**
Cat. S15031 12V 2.6 AH **$39.50**
Cat. S15031 12V 4.5 AH **$49.95**

FREE STANDING, FOLD UP MAGNIFIER

An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc
Cat. T12083 **$14.95**



INLINE SWITCHING BOX

- 25 pin "D" plug to 25 pin "D" socket (RS232)
- DIP switches allow easy switching of internal wiring

Cat. P **$32.95**

TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm
- Cream colour cable

Cat. Y16026 **$6.95**

TRACKBALL

Durable, accurate and reliable, and with dual fire buttons, these new trackballs are suitable for use with the Commodore VIC-20, Atari home video game, Atari 400 and 800 home computer and Sears Arcade Game.
Cat. C14225 ..... **$39.95**

DELUXE JOYSTICK

Suits Commodore 64, VIC-20, Atari, Sears, NEC PC-6001 computers or video games.
Cat. C14220 ..... **$14.95**

QUICK STICK JOYSTICK

Features:
- 3 Fast Responsive Firing Buttons.
- Arcade joystick feeling.
- Comfortable Grip.
- Built in stabilizing Grip
- Compatible with...
  Commodore 64, VIC-20,
  Atari,
  Sears
  NEC PC-6001

Cat. C14215 ..... **only $9.95**

"SNAP TOGETHER" PLASTIC CABINET

Top and bottom simply snap together (no screws required), removable front and back panels.
Dimensions 186(W) x 125(D) x 50(H)mm
Cat. H10116 **$6.95**

CENTRONICS GENDER CHANGER

- Female to Female
- Saves modifying or replacing non-mating Centronics cables
- All 36 pins wired straight through

Cat. X15662 **$33.95**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!
Features...
- Smoked plastic cover
- Lockable (2 keys supplied)
- High impact ABS plastic base
- Dividers/spacers

Cat. C16020 **ONLY $19.50**

HI FI SPEAKERS

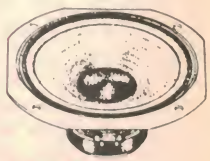
A comprehensive range of matched appearance speakers, all with square silver grey frames and black cones - ideal for building up low cost speaker systems that will look and sound superb.

1½" TWEETER

SPECIFICATIONS:
Sensitivity: 90dB
Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10200 **$4.95**

4½" MIDRANGE WITH SEALED BACK

Clothed edge surrounds.
SPECIFICATIONS:
Sensitivity: 97dB
Freq. Response: 600 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10206 **$12.95**



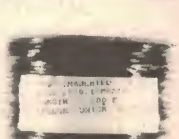
12" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 92dB
Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13 3oz
Cat. C10214 **$39.95**

12" HIGH POWER MUSICAL SPEAKER

- Aluminium die cast chassis
- Carbon fibre impregnated cone paper
- Foam edge
- Light grey cone, silver dust cap
- High temperature "NOMEX" voice coil.

SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 50-4kHZ
Impedance: 8 ohms
Power RMS: 60 watt
Magnet Weight: 30 oz
Cat. C10216 **$59.95**



HOOK UP WIRE

Cat. No.	Description
W11251	13/.12 TND BLK
W11252	13/.12 TLD BROWN
W11253	13/.12 TLD ORANGE
W11254	13/.12 TLD YELLOW
W11255	13/.12 TLD GREEN
W11256	13/.12 TLD BLUE
W11257	13/.12 TLD WHITE

PRICES PER 100 METRE ROLL
1-9 **$5.95** 10+ **$5.00**

W11260	14/.20 RED
W11261	14/.20 BLACK
W11265	14/.20 BLUE
W11268	14/.20 WHITE

PRICES PER 100 METRE ROLL
1-9 **$12.00** 10+ **$10.00**

W11270	24/.20 RED
W11272	24/.20 BLACK
W11274	24/.20 GREEN

PRICES PER 100 METRE ROLL
1-9 **$14.00** 10+ **$12.00**

W11280	32/.2 BROWN
W11282	32/.2 BLUE

PRICES PER 100 METRE ROLL
1-9 **$20.00** 10+ **$18.00**

MICRODOT DISKS

100% certified and error free guaranteed!
Where else can you get 100% guaranteed disks at these prices?!

	1-9 boxes	10+ boxes
5¼" S/S (C12440)	**$17.95**	**$16.95**
5¼" D/S (C12445)	**$19.95**	**$17.95**

Bulk and dealer inquiries welcome please phone (03) 543 2166

FREE POSTAGE FOR ALL ORDERS OVER $50!
FREE POSTAGE FOR ALL ORDERS OVER $50!

FREE POSTAGE FOR ALL ORDERS OVER $50! FREE POSTAGE FOR ALL O

NICADS!

Size	Desc.	1-9	10+
AA	1.2	A.H.	$1.95	$1.75
C	1.2	A.H.	$7.95	$6.50
D	1.2	A.H.	$7.95	$6.50

DIRECT IMPORT
NEW!

HIGH INTENSITY LED DISPLAYS

Overall Dimensions:
12.7mm across, 19mm high.
Cat. Z10190

1-9	10+	100+
$1.75	$1.50	$1.30

DIRECT IMPORT

HIGH INTENSITY LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 5 x 1mm
Cat. Z10180

1-9	10+	100+
$2.95	$2.75	$2.50

NEW!

SPEECH SYNTHESISER CHIPS!

SPO256A-AL2: Speech synthesiser chip, needs programming to work. $13.95

CTS256-AL2: Contains the code recognition circuit to enable the project to plug directly on the printer port, or into an IBM PC. $27.95

A SET OF EACH . $39.50

NEW! DIRECT IMPORT!

IBM* COMPATIBLE DISK DRIVES

Are you sick of paying up to 100% more for Japanese Disk Drives? We now have "direct import" disk drives at much lower prices!

Description	1-9	10+
500K	$179	$169
1 M/Byte ..	$219	$199
1.6 M/Byte	$239	$219

BRAND NEW FANS

Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

240V 4⅝" Cat. T12461 **$12.95**
115V 4⅝" Cat. T12463 **$12.95**
240V 3½" Cat. T12465 **$12.95**
115V 3½" Cat. T12467 **$12.95**
10+ fans (mixed) only $10 each!

SPECTROL MULTIDIALS

Model 16-1-11 (.9")
Cat.R14400 ..... **$16.95**
Model 18-1-11 (1" x 1.75" Rect.)
Cat.R14405 ..... **$38.50**
Model 21-1-11 (1.82")
Cat.R14410 ..... **$37.50**

PROTOCARD FOR IBM*

- Size 335 x 101mm (approx.)
- 5,000 holes (approx.)
- 1mm diameter
- Double sided
- Plated through
- Solder pad both sides
- Gold plated edge connector

Cat. H19110 ..... **$49.50**

EXTENDER CARD FOR IBM*

Now available! How long have you been waiting for one of these?
Cat. H19115 ..... $49.50

BREADBOARDS

Cat. No.	Description	Price
P11000	100 Holes	$ 2.75
P11005	640 Holes	$10.75
P11007	640+100 Holes	$13.00
P11009	640+200 Holes	$17.50
P11010	1280+100 Holes	$19.95
P11011	1280+300 Holes	$32.50
P11012	1280+400 Holes	$36.75
P11015	1920+500 Holes	$57.50
P11018	2560+700 Holes	$64.95

DPM-200 PANEL METER

- **Ultra Low Power**
- **Separately Addressable Annunciator**
- **15mm Digits**
- **Bandgap Reference**

A low profile LCD DPM with a range of useful symbols as shown. The DPM 200 features 15mm 3½ digit display, and ultra low current consumption and a bandgap reference for high stability. It also features Auto-zero, Auto-polarity, 200mV fsd. It may be used in single-ended, differential or ratiometric modes. The fsd can be easily changed by the user to indicate any other units. The decimal points and symbols can all be driven from an internal source. Wide supply and symbols can all be driven from an internal source. Wide supply rail (5-15V DC) with a variable threshold low battery warning indicator. Supplied with mounting clips and comprehensive data sheet.

SPECIFICATIONS:
Accuracy: 0.1% + – 1 digit
Linearity: + – 1 digit
Samples/sec: 3
Temp. Stability: 50 ppm typical
Temp. Range: 0 - 50°C
Supply Voltage: 5 - 15V DC
Supply Current: 50uA typical
Max DC Input Volts: + – 20V

Cat. Q15510 **$99.95**

RS232 & 'D' TYPE SPECIALS

Part	Description	Cat.No.	Price
DE9S	9 pin Female	P10881	$1.75
DE9P	9 pin Male	P10880	$2.25
DE9C	9 pin cover	P10882	$1.95
DA15P	15 pin Male	P10890	$2.10
DA15S	15 Female	P10891	$2.25
DA15C	15 pin cover	P10892	$1.15
DB25P	25 pin Male	P10900	$1.95
DB25S	25 Female	P10901	$2.95
DB25C	25 pin cover	P10902	$1.20

RED HOT SPECIALS
to bring you out of hibernation!

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

Cat. A12030 **NORMALLY $19.95**
SPECIAL, ONLY $14.95

SAVE

RITRON 2 MONITORS

Stylish, swivel base monitor, available in amber or green.
Green Cat. X14506 **Normally** $215
Amber Cat. X14508 **Normally** $219
SPECIAL, ONLY $199

CRAZY SPECIAL!

CRYSTALS SPECIALS

We simply have too many of these prime spec. crystals in stock!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$6.00	$5.20
1.8432MHz	Y11003	$6.00	$5.20
4MHz	Y11020	$2.00	$1.60
4.194304MHz	Y11022	$2.00	$1.60
4.433618MHz	Y11023	$2.00	$1.60
4.75MHz	Y11025	$2.00	$1.60
4.915200MHz	Y11026	$2.00	$1.60
5MHz	Y11030	$2.00	$1.60
6MHz	Y11040	$2.00	$1.60
6.144MHz	Y11042	$2.00	$1.60
6.670MHz	Y11045	$2.00	$1.60
8MHz	Y11050	$2.00	$1.60
8.867238MHz	Y11055	$2.00	$1.60
10MHz	Y11060	$2.00	$1.60
12MHz	Y11070	$2.00	$1.60
14.31818MHz	Y11072	$2.00	$1.60
15MHz	Y11075	$2.00	$1.60
18MHz	Y11082	$2.00	$1.60
18.432MHz	Y11085	$2.00	$1.60
20MHz	Y11090	$2.00	$1.60

SAVE $30!

APPLE* COMPATIBLE SLIMLINE DISK DRIVES

Japanese Chinon mechanism,
Cat. X19901 Normally $225
NOW $195
(*Apple is a registered trade mark.)

VALUE!

MITSUBISHI DISK DRIVES

MF353 (3½" DRIVE)
Double sided, double density.
1 M/Byte unformatted, 80 track per side.
Cat. C11953 **$280**

M2896-63
Slimline 8" Disk Drive, Double sided Density No AC power required. 3ms track to track, 1.6 Mbytes unformatted, 77 track side 10s/su10 bit soft error rate.
Cat. C11916 **$895**
Case & Power Supply to suit
Cat. X11022 **$159**

M4854
Slimline 5¼" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1.6Mbyte unformatted 3ms track to track access, 77 track/side.
Cat. C11904 **$375**
Case & Power Supply to suit.
Cat. X11011 **$109**

M4853
Slimline 5¼" disk drive. Double sided, double density, 1 Mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.
Cat. C11903 **$295**

M4851
Slimline 5¼" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system
Cat. C11901 **$249**
Case & Power Supply to suit
Cat. X11011 **$109**

M4855
Slimline 5¼" disk drive, double sided, double density, 96 track/inch. 2.0 Mbytes unformatted.
Cat. C11905 **$385**

PANEL METERS GALORE!

We have a great range of panel meters at great prices!

Cat.No.	Description	Price
Q10500	MU45 0-1mA	12.50
Q10502	MU45 50-0/50uA	12.50
Q10504	MU45 0-100uA	12.50
Q10510	MU45 0-5A	12.50
Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95

FUSE SPECIAL 3AG

Two values, 3 Amp and 1 Amp

1-99	100-999	1000+
8¢ each	6¢ each	5¢ each

CORDLESS RECHARGEABLE SOLDERING IRON

- Built in solder point illumination
- Easy replacement of solder tip
- Protective stand which also functions as charging unit
- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instruction manual
- 12 months warranty

Cat. T12480 ..... Normally $69.95
SPECIAL, $59.95

SAVE

IC SPECIALS!

	1-9	10+	100+
4116	$3.95	$3.75	$3.50
4164	$2.95	$2.75	$2.50
2716	$5.90	$5.50	$5.50
2732	$6.25	$5.95	$5.50
2764	$6.25	$5.95	$5.00
27128	$6.95	$6.50	$6.25
6116	$2.95	$2.75	$2.50
41256	$6.95	$6.50	$6.00
6264	$6.50	$5.50	$5.25
27256	$11.50	$10.50	$10.00

WORLD MODEM CHIP

Cat. U21614 Normally $49.50
Save $20, SPECIAL $29.50

RITRON 19" RACK CASE

Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.
Cat. H10415 **Normally $47.95**
SPECIAL, ONLY $42.95

NEW!

ARGUS 726 ADJUSTABLE MAGNIFIER WITH LAMP

Absolutely perfect for close up work! Intricate PCB's, projects, etc., will be a breeze under this superb, adjustable magnifying lamp.

- Magnifies 1.75 times
- 40 watt incandescent lamp
- 2 spring-balanced arms, extendable to 95cm
- Adjustable head for optimum viewing angle
- Comes with desk clamp (interchangeable with base)
- Fantastic Value!!

Cat **Our price $89**

SAVE $10!

DIGITAL SPEEDO/ DIGITAL TACHO/ SPEED ALERT

- Digital readout (LED) for both tacho and speedo.
- Alarm with sound at variable preset speed.
- Audible beeper and visual indicator.
- In built light indicator for night illumination.
- Designed for 12 volt negative earth electrical systems.
- Speedo: 0 - 199kph
- Tachometer: 0 - 9900kph
- Speed alert: 40 - 120kph
- Complete with mounting hardware.

Cat. A15064 **Normally $69.50**
SPECIAL, ONLY $59.50

PC BOARD HOLDER

Better than an extra pair of hands! A must for all PCB work.
Cat. T12444 ..... $9.95

CODE KEY PAD

- Telephone type digital keypad.
- Four digit, changeable code.
- Over 5000 possible combinations.
- Power consumption: 5mA standby, 50mA alarm.
- Two sector LED and 1 arm LED.
- Wrong number lockout.
- 12V DC operation.
- Relay output.
- Panic button.
- Normally open tamper switch.
- Dimensions: 145 x 100 x 37mm
- ACP3 compatible.

Cat. A13014 **Normally $69.50**
SPECIAL, ONLY $55.60

UNIVERSAL BATTERY CHARGER AND TESTER

Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for D, C, AA, AAA, N, button and cell batteries, 9V and 6V (square types). Comes complete with detailed instructions.

Cat. M23533 **$27.95**

Rod Irving Electronics
48 A'Beckett St, MELBOURNE
Phone (03) 663 6151
425 High St, NORTHCOTE
Phone (03) 489 8866
Mail Order and Correspondence:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938

MAIL ORDER HOTLINE (03) 543 7877 (2 lines)

POSTAGE RATES:

$1 – $9.99	$2.00
$10 – $24.99	$3.00
$25 – $49.99	$4.00
$50 – $99.99	$6.00
$100 plus	$12.50

FREE POSTAGE FOR ALL ORDERS OVER $50!

This is for basic postage only. Comet Road Freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included free!
Registered Post for orders over $200 included free!

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE,
56 Renver Rd, Clayton.
Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

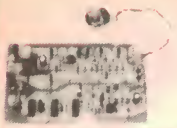
*Apple and IBM are registered trade names.

MasterCard VISA

FREE POSTAGE FOR ALL ORDERS OVER $50! FREE POSTAGE FOR ALL ORDERS OVER $50!

FREE POSTAGE FOR ALL ORDERS OVER $50! FREE POSTAGE FOR ALL ORDERS OVER $50!

FREE POSTAGE FOR ALL ORDERS OVER $50!



VIDEO FADER CIRCUIT

Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.
(EA Jan '86, 85tf10)
Cat K86010 **$19.95**

AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder.
(81AO10) (EA Oct '81)
Cat. K81101 **$59.50**

SONICS ACTIVE DIRECT INSERTION BOX.

This inexpensive, easy to build DI box was designed in conjuction with Sonics magazine and is fine for both live PA and home recording work. It takes an unbalanced input and produces an output suitable for driving a balanced audio line.

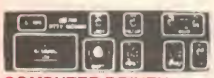
SPECIFICATIONS:
S/N Ratio: 100dB (ref 0dBM)
Distortion: 0.03% at 4dBM
Input Impedance: 500k nominal (unbalanced)
Output Impedance: 600 ohm nominal (balanced)
(ETI 1401 Sept '85)
Cat. K41401 **$39.95**

HUMIDITY METER

This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI-256 (Includes humidity sensor $19.50)
Cat. K52460 **$29.50**

15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage. (ETI 581, June '76)
Cat. K45810 **$19.50**



COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER

Here's what you've been asking for, a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are avaialble on interfacing the unit to other computers. (ETI Nov '84) ETI 755)
Cat. K47550 **$139**

PH METER KIT

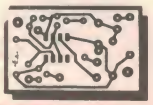
Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3½ digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.
(EA Dec.'82) 82PH12
Cat. K82123 **$135**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time, without glow plug burnouts on your model engines.
(ETI June'83) ETI 1516
Cat. K55160 **$49.50**

MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug.'81) 81MC8
Cat. K81080 **$99**



PRINTED CIRCUIT BOARDS

ETI 044	$2.95
ETI 163	$7.95
ETI 164	$2.95
ETI 183	$6.95
ETI 256	$2.95
ETI 268	$1.95
ETI 278	$3.95
ETI 324	$4.95
ETI 412	$3.95
ETI 449	$2.80
ETI 453	$2.95
ETI 455	$3.95
ETI 458	$6.95
ETI 464	$3.95
ETI 466	$9.95
ETI 477	$9.95
ETI 478SA	$2.95
ETI 478SB	$1.95
ETI 478SC	$1.95
ETI 478SD	$1.95
ETI 480	$2.95
ETI 494	$3.95
ETI 496	$5.95
ETI 499	$7.95
ETI 581	$3.95
ETI 666	$3.95
ETI 668	$4.95
ETI 672	$2.95
ETI 688A	$4.95
ETI 688B	$2.95
ETI 699	$8.95
ETI 724	$2.95
ETI 733	$5.95
ETI 736A	$3.95
ETI 736B	$3.95
ETI 755A	$8.95
ETI 755B	$2.95
ETI 755C	$2.95
80pa6	$15.95
80pg6	$7.95
80bm10	$3.95
82ps2	$6.95
82eg2	$2.95
82vc3	$4.95
82pa7	$11.95
82pc10	$3.95
83ma11	$5.95
84au1	$2.95
84ma11	$2.95
85ef11	$7.95
AEM 4600	$21.95

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April '82, 82AO3A/B)

Note: The RIE Function Generator has a high quality screen printed and prepunched front panel!
Cat. K82040
Cat. K82041 **$109**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr '83)
Cat. K47330 **$19.95**

ELECTRIC FENCE

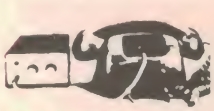
Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automative igintion coil, it should prove an adequeate deterrent to all manner of livestock. Additonally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept '82) 82EF9
Cat. K82092 **Normally $19.95**
SPECIAL, ONLY $14.95

TRANSISTOR TESTER

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept '83) 83TT8
Cat. K83080 **Normally $18.95**
SPECIAL, ONLY $14.95

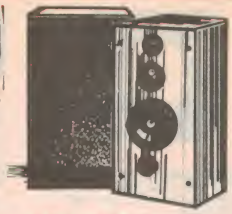
PLAYMASTER 300 WATT AMPLIFIER

This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complemetary or quasi-complementary versions, so output transistor shortages should be no problem at all.
(80PA6) (EA July '80)
Cat. K80060 **Normally $109**
SPECIAL, ONLY $99



PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb.'84) 84TP2
Cat. K84021 **$27.50**



VIFA/AEM 3 WAY SPEAKER KIT!

This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
2 x P25 woofers
2 x pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D19 DOME TWEETER SPEAKER SPECIFICATIONS
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20kHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2ohms
Moving Mass: 0.2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts (fo: 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7.2ohms
Moving Mass (incl. air): 3.6 grams
Weight: 0.65kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters: Qm: 3.15 Qe: 0.46 Qt: 0.40 Vas: 180.1
Weight: 1.95kg

Speaker Kit Cat.K90000 **$779**
Cabinet Kit Cat.K90000 **$309**
All Together Cat.K90000 **$989**
(Save a huge 110!)

DIGITAL SAMPLER KIT

Digital sampling is at the core of many of the special sound effects used by modern musicians. A trigger input (usually a construction drum pad) triggers a prerecorded sound from the digital sampler. This sound has been recorded into the 4K of onboard memory and can be digitally manipulated so that it sounds completely different on playback. The unit has controls for gain, regeneration and mixing. It also gives a choice of a number of different triggering methods.
(ETI 1402 May, June, July '86)
Cat. K41420
Please phone for price and availability

LISTENING POST

This device attaches between the audio output of a shortwave receiver and the input port of a computer. It allows decoding and printing out of morse code, radioteletype (RTTY) and facsimile (FAX) pictures using the computer. It has been designed from all readily available parts. Details for writing the software program are included.
(AEM 3500, July '85)
Cat. K93015 **$37.95**

AEM DUAL SPEED MODEM

The ultimate kit modem featuring 1200/300 baud, case etc. Exceptional value for money!
(AEM 4600 Dec '85)
$169

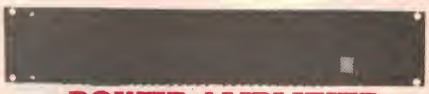
STROBE KIT

Includes perspex cover!
(AEM 9500)
Cat. K93018 **$59.95**

SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

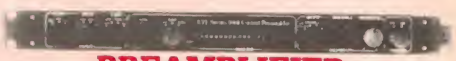
By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,000 sold!
For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.



POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS SERIES 5000 POWER AMP...
• 1% Metal Film...
SPECIAL, ONLY $329
SAVE $30
...IRVING ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms
POWER AMPLIFIER: 100W RMS into 8 ohms (+ – 55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0=.0.4 dB 2.8Hz to 65KHz, +0=3 dB. NOTE: These figures are determined solely by passive filters.
INPUT SENSITIVITY: 1 V RMS for 100W ouput.
HUM: 100 dB below full output (flat).
NOISE: 116 dB below full output (flat, 20KHz bandwidth).
2nd HARMONIC DISTORTION: ‹0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a +=56V SUPPLY rated at 4A continues ‹0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above).
INTERMODULATION DISTORTION: 0.003% at 100W. (50Hz and 7KHz mixed 4:1).
STABILITY: Unconditional.
Cat. K44771 **$359**
Assembled and tested $549
packing and post $10



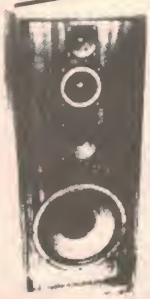
PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS...
SPECIAL, ONLY $299
SAVE $20
...VARIOUS.
...not a commercial unit available that sounds as good!)

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz = 130KHz, +0.=1dB Low-Level input-conforms to RIAA equalisation +=0.2dB
DISTORTION: 1KHz ‹0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)›92dB flat ›100dB A-weighted, MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected: ›86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal: ›71dB flat ›75dB A-weighted.
Cat. K44791 **$319**
Assembled and tested $599
packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands from 31.5Hz to 16KHz.
NOISE: ‹0.008mV, sliders at 0, gain at 0(=10...
20KHz BANDWIDTH DISTORTI...
sliders at 0, gain at...
FREQU...
SPECIAL, ONLY $209
SAVE $10
...unit: **$219**
$429
packing and postage $10

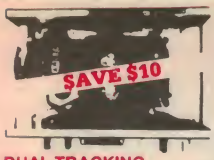


SERIES 4000 SPEAKERS

Please call for price and availability

Errors and Ommissions Excepted

FREE POSTAGE FOR ALL ORDERS OVER $50!
FREE POSTAGE FOR ALL ORDERS OVER $50!



DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. (EA March '82) 82PS2

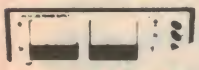
Cat. K82030 ..... Normally $109

SPECIAL, $99

PH METER KIT

Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well. (EA Dec.'82) 82PH12

Cat. K82123 ..... **$135**



50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design. (Ea May,June'83) 83PS5

Cat. K83050 ..... Normally $169

SPECIAL, $159

OP AMP TESTER

The Op Amp Tester which could save you hours in agonising whether that old op amp thats been sitting in the draw for the last year. (ETI April '85, ETI 183)

Cat. K41830 ..... Normally $26.50

SPECIAL, $21.50

CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superb unit which provides five separate patterns; dot, crosshatch, checker board, grey scale and white raster? **Note:** The RIE kit includes a large ABS type case! (80pg6, EA June '80)

Cat. K80033 ..... Normally $67.50

SPECIAL, $62.50

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current meterng is provided. (ETI Dec.'83) ETI 162

Cat. K41620 ..... Normally $59.50

SPECIAL, $44.50

SLIDE CROSS-FADER

Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built vanalbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov.'81) 81SS11

Cat. K81110 ..... Normally $99.00

SPECIAL, $89.00

MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.

Specifications:

- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing; suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charge circuit.
- Built-in siren driver.

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!

Cat. K85900 ..... Normally $129

SPECIAL, $119

ELECTRIC DUMMY LOAD

With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests. (ETI Oct.'80) ETI 147

Cat. K41470 ..... Normally $129

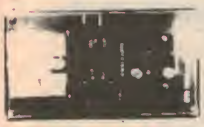
SPECIAL, $119

DELUXE CAR BURGLAR ALARM

Stop your car from being one of the 70,000+ stolen cars stolen each year with this "state of the art" car burglar alarm. Features include key switch operation, delayed entry and exit, automatic reset, and provision for an auxiliary battery. Further more, of the 10 most important features listed by NRMA, this EA Deluxe Car Alrm has 9 of them! (84ba5, EA May '84)

Cat. K84050 ..... **$79.50**

RED HOT SPECIALS to bring you out of hibernation!

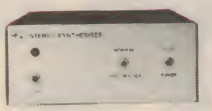


LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms. (ETI Nov.'81) ETI 158

Cat. K41580 ..... Normally $39.50

SPECIAL, $34.50



STEREO SYNTHESISER FOR TUNERS & VCRs

Enjoy the benefits of stereo sound from your VCR, TV or AM tuner with this Stereo Synthesiser. The circuit uses just four IC's and is easy to build. (82ms8, EA September '82)

Cat. K82091 ..... **$55.00**

EPROM COPIER

This versatile EPROM copier is easy to build and will cost less than $100. It can program 2716 and 2732 EPROMs and copy 2708, 2716 and 2732 devices. (84ec11, EA November '84)

Cat. K84110 ..... **$99**

SERIES 3000 COMPACT STEREO AMPLIFIER

A quality compact amp that doesn't sacrifice performance! This amp delivers 20W per channel, has low distortion and costs less than $100!

SPECIFICATIONS:

Power Output:
25W RMS, one channel driven
20W RMS, both channels driven

Distortion:
1kHz: 0.03% at full power
0.013% at 12W RMS
10kHz: 0.08% at full power

Frequency response
Phono: within 1 dB, RIAA
Other inputs: within + – 0.5dB from 10 Hz to 20kHz: – 3 dB at 40kHz

Hum:
Phono: – 60 dB w.r.t. 10 mV input
Other inputs: – 70 dB w.r.t. 200 mV input

Noise:
Phono: – 80 dB w r.t. 10 mV input
Other inputs: – 86 dB w r.t. 200 mV input

Tone Controls:
Bass: + – 10 dB at 50 Hz
Treble: + – 10 dB at 12kHz

Slew Rate:
15V/us

Seperation:
Phono: 46 dB
Other inputs: 40 dB

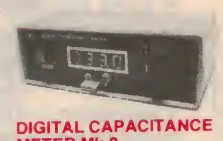
Sensitivity:
Phono: 2.5 mV for full output
Other inputs 200 mV for full output
(ETI 476, Nov. '80)

Cat. K44760 ..... **$95.00**

FREQUENCY STANDARD

Get the equivelent of a rubidium frequency standard by draping a piece of wire over the back of your TV set!! Believe it or not your humble television can provide an extremely stable and accurate reference frequency. The wire acts as a transducer to pick up electromagnetic radiaton from the back of the set. Normally you would need to spend thousands of dollars to achieve accuracy beyond the "parts per thousand" you expect from ordinary meters. With this simple project, an extremely accurate 1MHz signal can be derived for very little outlay. (ETI 174, July '86)

Cat. K41740 ..... **$24.95**



DIGITAL CAPACITANCE METER Mk.2

Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.

***Note:** The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display!* (80cm3a, EA August '85)

Cat. K80030 ..... **$59.50**

SPEAKER PROTECTION UNIT

An expensive speaker system can be readily destroyed by a 20 watt amplifier. Carelessness with a high power amplifier can melt voice coils like cheese on toast. However, with this Speaker Protection Unit you can avoid risking the misery and expense (ETI455,)

Cat. K44550 ..... **$44.95**

300 BAUD DIRECT CONNECT MODEM KIT

Think of the advantages of having your own modem!!

- Can't afford a floppy disc? Use your telephone to access one for the cost of a call.
- Bored with your old programs? Download hundreds of free programs.
- Want to get in touch with fellow computer enthusiasts? Use 'electronic mail'
- Ever used a CP/M system? CP-DOS? UNIX? Well a modem will make a your computer a remote terminal on some of the most exciting systems around.

Save on ready built modems. (ETI 699, May '85)

Cat. K46990 **Normally $129**

SPECIAL, ONLY $109

(Short form without phone)

ELECTRIC FENCE TESTER

This project was developed to take some guess work out of testing or checking an electric fence. Many factors can influence the operation of an electric fence energiser and fence, reducing its effectiveness. This tester indicates the presence of each pulse from the energiser and shows when the pulse voltage exceeds an amplitude of 2kV, 3kV and 5kV, once calibrated. If used in an uncalibrated mode , the unit will indicate pulse amplitudes on the fence of 40%, 60% and 100% of energiser output. (ETI 1512, Feb '83)

Cat. K55120 ..... **$19.95**

CRYSTAL MARKER GENERATOR FOR RECIEVER AND CRO CALIBRATION

A simple but very useful piece of test equipment for calibrating and aligning recievers, transceivers and oscilloscopes. It is portable, battery operated and inexpensive to build. (ETI 157, October '81)

Cat. K41570 ..... **$37.50**

BIT PATTERN GENERATOR KIT

In applications where you are required to look for a particular byte of information in a senal or parallel data path, short of a logic analyser or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and economical way to detect and display specific bytes of data. It may be used on both parallel and senal data paths. (ETI 172, May '86)

Cat. K41720 (Senal/Parallel Kit)

Please phone for price

50/500MHz 7 DIGIT FREQUENCY METER

Want a high performance digital frequency meter that's easy to to build? This unit uses just five IC's, measures period and frequencies up to 500MHz, and features a bright seven digit display. Save a small fortune over comparable commercail units.

Note: The RIE Frequency Meter Kit includes high quality prepunched and silk screened front panel! (EA December '81) (50MHz 81fm10a, 500MHz 81fm10b)

50MHz Cat. K81120 ..... **$149**

500MHz option Cat K81121

add $29.95

BRIDGING ADAPTOR CONVERTS SERIES 5000 POWER AMPLIFIER INTO 300W MONO AMPLIFIER

Here's how to operate the two ETI477 MOSFET power amplifier in the series 5000 amp in bridge configuration with the addition of a simple, inexpensive module that fits inside the 5000 power amp

SPECIFICATIONS:

Power Output:
300W RMS into 8 ohms (at onset of clipping)

Frequency Response:
8 Hz to 20 kHz, +0 – 0.5dB (determined by passive filters)

Input Sensitivity:
1V RMS for 100W output

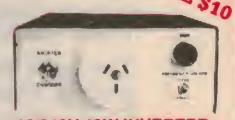
Hum and Noise:
– 100dB below full output or better

Total Harmonic Distortion:
less than 0.003%

Stability:
Unconditionally stable

(ETI 479, March '82)

Cat. K44790 ..... **$19.50**



12/240V 40W INVERTER

This 12 240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May '82) 82IV5

Cat. K82050 ..... Normally $69.95

SPECIAL, $59.95

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COMING EVENTS

SEPTEMBER

A series of 1 day and 2 day courses on using **computers in business** is being conducted by Management Technology Education Centres in Sydney and Melbourne throughout September. For details contact MTE on (02) 290-3555 or (03) 67-7117.

ACC '86 — Australian Computer Exhibition — incorporating the 2nd national micro and PC exhibition will be held 23 to 26 September in the Royal Exhibition Building, Melbourne. Contact Trevor Riddell, Riddell Exhibition Promotions on (03) 429-6088.

ACC '86 Software & Computer Exhibition is on at the Chevron Hotel, Surfers Paradise 16 to 18 September. Contact Riddell Exhibition Promotions on (03) 429-6088.

The Power Engineering Society of the IEEE is holding the **1986 Transmission and Distribution Conference and Exhibition** in Anaheim, California, 14 to 19 September. Contact Noela Cain at the US Consulate in Melbourne on (03) 697-7900 for more info.

The **Society of Manufacturing Engineers** is conducting a series of workshops on manufacturing and manufacturing automation protocol in September in Melbourne, Adelaide, Sydney and Brisbane. Contact A. Greco & Associates on (02) 875-2377 for information on venues, dates and topics.

A **seminar on space research** will be held 10 and 11 September at the Southern Cross Hotel, Sydney. Contact Concise Communications on (02) 438-2955.

The eighth international conference for computer communication, **ICCC '86** will be held in Munich, 15-19 September. Contact Commercial Services Department, Telecom, 18th Floor, 199 William St, Melbourne, Vic 3000, (03)606-5152.

The Small Business Trade Fair '86 will be held at Centrepoint in Sydney, 4-7 September. For details on displays or booths, contact Thomson Exhibitions, 47 Chippen St, Chippendale, NSW 2008. (02)699-2411.

The **Shepparton and District Amateur Radio Club** is holding its Communications Day on Sunday, 7 September, 1986, at the Shepparton Showgrounds. For more information contact Peter O'Keefe VK3YF, PO Box 692, Shepparton, Vic 3630. (058) 21-6070.

OCTOBER

Pacex, an international process and control exhibition will be held 21-23 October in Melbourne. Contact Thomson Exhibitions, 47 Chippen St, Chippendale, NSW 2008. (02) 699-2411.

If surface finishing is your go, the **Asia Pacific Interfinish Congress and Exhibition** will be held 26-30 October in Hobart. You can get more details from the Australian Institute of Metal Finishing, 191 Royal Pde, Parkville, Vic 3052. (03)347-2562.

Professional Engineers Week '86 will be held 4 to 12 October with variously located public meetings and displays. Contact Kelvin Lillingstone-Hall on (03) 606-7559.

Conventions on **Engineering Education** will be held 6 to 7 October nationally. Contact Barry Hewish on (062) 73-3633.

Electronics 86, the Australian International Electronics and Computer Technology Exhibition and Conference, opens from 7-9 October, 1986, at the Royal Showground in Adelaide.

NOVEMBER

Infotex 86, a computer and electronics exhibition presented by the NSW Chamber of Manufacturers and the Australian Computer Society will be held 4-6 November in Canberra. For further details contact Atek Promotions, 131 City Walk, Canberra, ACT 2601. (062)49-7799.

Aussat will hold a conference for satellite users — **Aussat '86: New Horizons** on 5 and 6 November at the Hyatt Kingsgate Hotel in Sydney. Contact Aussat Public Affairs Dept on (02) 238-7800.

The 1st Australian Artificial Intelligence Congress and Exhibition will be held 18 to 20 November, Hyatt on Collins. Contact (02) 439-5133.

The **14th National Conference for Australian Urban and Regional Information Systems** will be held 25 to 28 November at the Regent in Melbourne. Contact Stuart Hunter on (03) 617-9547.

Munich will be host to **Electronica '86,** the 12th international trade fair for electronic components and assemblies. Set aside 11-15 November. More details are available from the German Australian Chamber of Industry and Commerce on (02)29-3999.

DECEMBER

The third **'mathematics-in-industry' study group** will be held at Monash University, Melbourne, from 1 to 5 December, 1986. Further information is available from Dr F.R. de Hoog, CSIRO Division of Mathematics and Statistics, GPO Box 1965, Canberra, ACT 2601. (062) 82-2011.

The **11th Optical Fibre Technology Conference** will be held 1 to 4 December. Contact the Institute of Radio & Electronics Engineers on (03) 606-6581 for more information.

The **Pacific Region Conference on Electrical Engineering Education** is on 15 to 17 December at Vue Grand, Queenscliffe, Vic. Contact John Hulskame at RMIT on (03) 660-2453 for more information.

The **Intelligent Autonomous Systems Conference** is on 8 to 11 December in Amsterdam. Contact Secretariat, Conference IAS, C/- Congressbureau "Van Neutegen", PO Box 27783, 3003 MB Rotterdam. (010) 433-3179.

FEBRUARY

Finance '87 Melbourne, an exhibition of money-handling technology, will be held at the World Trade Centre, Melbourne, 10 to 13 February. For further information contact BPI Exhibitions on (02) 266-9799.

MARCH

An **International CAD/CAM Congress** on current realities and future directions will be held 17 to 20 March in Melbourne. Contact ACADS/FACE Congress Secretariat, 576 St Kilda Rd, Melbourne, Vic 3004. (03) 51-9153.

The dates and venues for the two PC87s are as follows: **Eighth Australian Personal Computer Show,** Centrepoint, Sydney, 18-21 March, 1987; and **Ninth Australian PC Show** 'Communications 87', 'Office Technology 87', Royal Exhibition Building, Melbourne, 1-4 June, 1987.

APRIL

ATUG '87 4th Australian Telecommunications Exhibition & Conference will be held at the Hilton Hotel in Sydney 7 to 9 April. Contact Riddell Exhibitions on (03) 429-6088.

Labex '87, international lab and equipment and products exhibition, is on in Brisbane at the Science Pavilion, RNA Exhibition Grounds, 31 March to 2 April. Contact BPI on (02) 266-9799.

ADELAIDE SHOW TIME

The Australian International Electronics and Computer Exhibition and Conference is on again this year. It will be held in Adelaide between October 7 and 9, and so far looks like attracting a record breaking number of exhibitors and guests.

Jon Fairall

THE EXHIBITION WILL be held at the Royal Showground and will expose some of the big names in electronics in Australia, with naturally, a large representation from South Australia.

An interesting stand is expected from the Technology Park as well as the various defence and aerospace industries that cluster around Adelaide.

Among the more attractive stands will be Philips', which is trying to improve the visiblity of its Hendon semiconductor plant. It is likely that the display will include an automatic testing station similar to one used in the plant in the manufacture of thick film hybrid. According to Dave Segal, the Manager of Philips Microelectronics, the aim of the exhibit will be to make people realise that semiconductor manufacturing is booming in Australia, and to give them a feel for the appearance of technology.

For the first time this year the conference is being run by a professional exhibition company, Australian Exhibition Services (AES). On previous occasions it was organized by the local South Australian electronics association. The hope is that with a professional organization behind it the event will become a theatre for Australian engineering excellence.

Major local manufacturer Teknis will be there in force. Particular lines to be pushed include QA automatic test equipment, magnetic sensing transducers from Servopole and VHF AM/FM direction finding equipment.

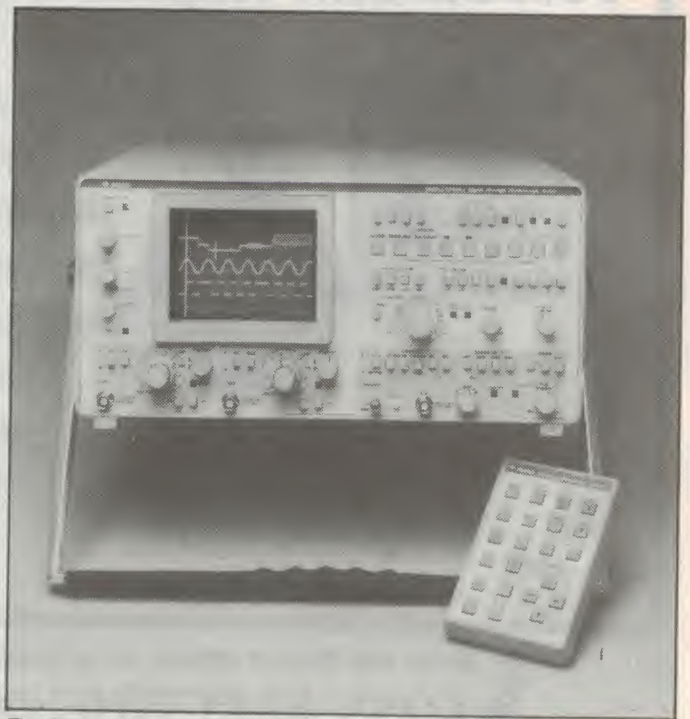
The local member of the George Brown Group, Protronics, will be out selling his wares as well. Protronics is supplier for Fairchild, NEC, Zilog and many other manufacturers.

Also present will be Alan Bradley Ltd, which has sourced some new solid state relays; Cliff Young from Brisbane will be showing off a battery of connectors and test equipment.

Sydney based Foss Electric will be represented by Heraeus Votsch of the Danish parent company. Foss imports chemical analysis systems, intensive care electronics and environmental simulation gear. The company is particularly proud of its simulation chambers, which have been sold to the Defence Department and Telecom.

Representing instrument makers will be Elmeasco Ltd, which has been a long time recipient of Telecom contracts, and will have on display a wide range of locally and overseas produced instrumentation.

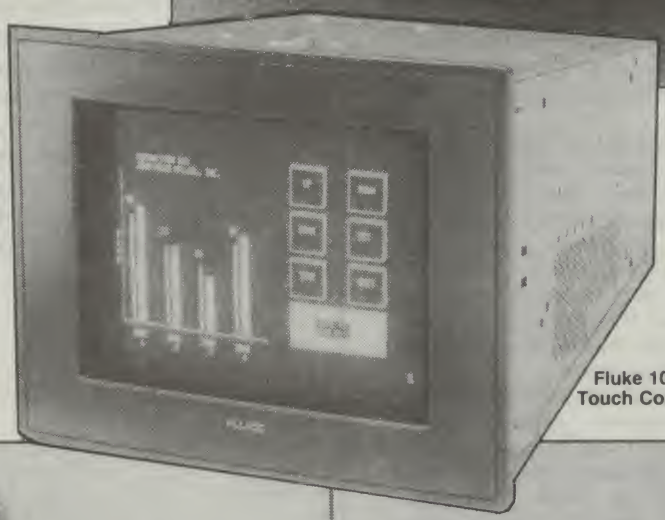
At the SA Technology Park British Aerospace headquarters are under construction.



The Gould 4050 digital storage oscilloscope.

Host city Adelaide.

The Fluke 37.



Fluke 1020 Series Touch Control Screen.

Cipher cartridge tape back-up systems for IBM-PC/XTs and compatible computers, controller/coupler boards and DEI cartridge tapes, will be front of house features.

Lots of new products from the Instrument Division will be shown, including the Gould Model 4050 digital storage oscilloscope with hand-held waveform processor, plus the Model 1425 connected to a personal computer via the IEEE-488 interface bus. The Meguro Model 1255 is another new arrival; this is a 100 MHz, 3 channel, 8 trace 'scope loaded with features.

A range of Fluke digital multimeters will be displayed, including the new Model 37 — a new style of bench/portable DMM and the 5½-digit 8842A — with true rms and IEEE-488 interface. The Fluke 9010A Microsystem Troubleshooter which comes ▶

The new HP 4971S protocol analyser.

with a wide range of interface pods will be demonstrated.

Also featured will be the range of IEEE-488 interface boards and software from National Instruments; these units can be fitted to a wide range of computers to enable them to be used as instrument controllers.

Look out also for the Fluke 1020 series Touch Sensitive Displays; these units feature a 12-inch screen, green or amber, with up to 120 separate touch locations.

Elmeasco will demonstrate the Data Electronics Data-Taker which offers very low cost, flexible data aquisition.

Hewlett-Packard will also weigh in with a range of high end instrumentation equipment for the local market.

The conference will run parallel with the exhibition and includes speakers from all over the world who will talk on a wide variety of topics. However, there is a bias towards the current South Australian predilections. For instance, remote sensing, space applications and microelectronics get quite a serve.

Another strand to the conference will be concern about the future direction of electronics. Various speakers will discuss new strategies in the communications industry, the state of the art in Australian manufacturing, and how to do business in electronics.

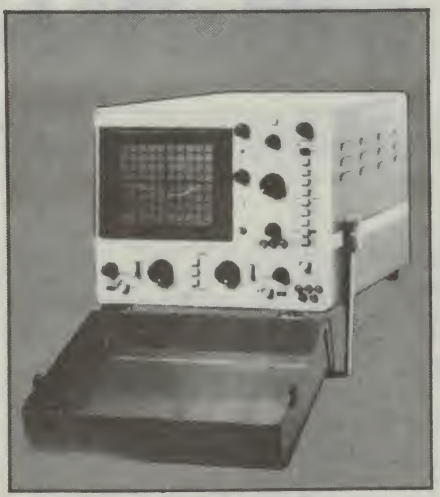
There will also be a series of parallel workshops, at which there will be opportunity for people to discuss issues in a more informal situation. Some of the topics include custom, semi-custom, surface mounting and gate array technology.●

150

1836 SOUTH AUSTRALIA 1986

20MHz OSCILLOSCOPES

With Component Tester



ETI READER SERVICE 10

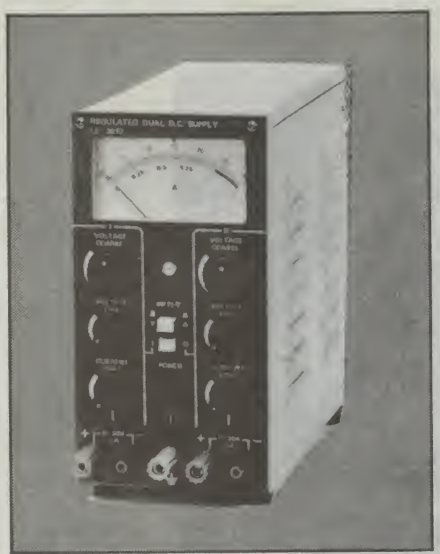
The APLAB oscilloscope Model 3132 is a dual trace 20 MHz scope with minimum sensitivity of 2mV/div and minimum sweep speed of 0.5 us/div.
Triggering modes include TV line or TV frame sync.

Other features include:

- Built in triple DC source +5V +12V ±12V
- Dual component tester comparator.

EX STOCK

LABORATORY POWER SUPPLIES



ETI READER SERVICE 11

APLAB offer a complete range of regulated DC bench/rack power supplies combining high precision and regulation capabilities with continuously adjustable outputs.
Designed with single, dual and multiple outputs, these power supplies can be used in either constant voltage or constant current mode of operation.
Standard models include:

SINGLE OUTPUT

OUTPUT: VOLTAGE:	OUTPUT CURRENT
0-30V	0-1A to 30A
0-70V	0-2A to 10A

DUAL OUTPUT

0-30V	0-1A to 2A

MULTIPLE OUTPUT

0-30V	0-2A to 5A

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SEE US AT STAND No. 662

ONE CHIP MICROS

S.K. Hui

Around the world the winds of change are blowing. One example is the computer on a single chip. And like a whirlwind chasing its tail, this chip is the product of bigger, quicker computers and has in turn encouraged their growth and development.

NOWADAYS, 32- and 64-bit machines are riding high. Computer hackers and programmers are talking in terms of words, not bytes. Much attention is placed on the 'calculating power', 'multi-user', 'multi-task' aspects of computer systems.

But while this trend continues towards the flying end of the market, a new breed of computer chip with a completely different architecture has been developed. As opposed to the gigantic 32- and 64-bit CPUs such as the Motorola 68020, the Intel 80386, 80186 and the Texas Instruments 32010, these tiny but low cost *single chip micros* are increasingly in demand for control applications.

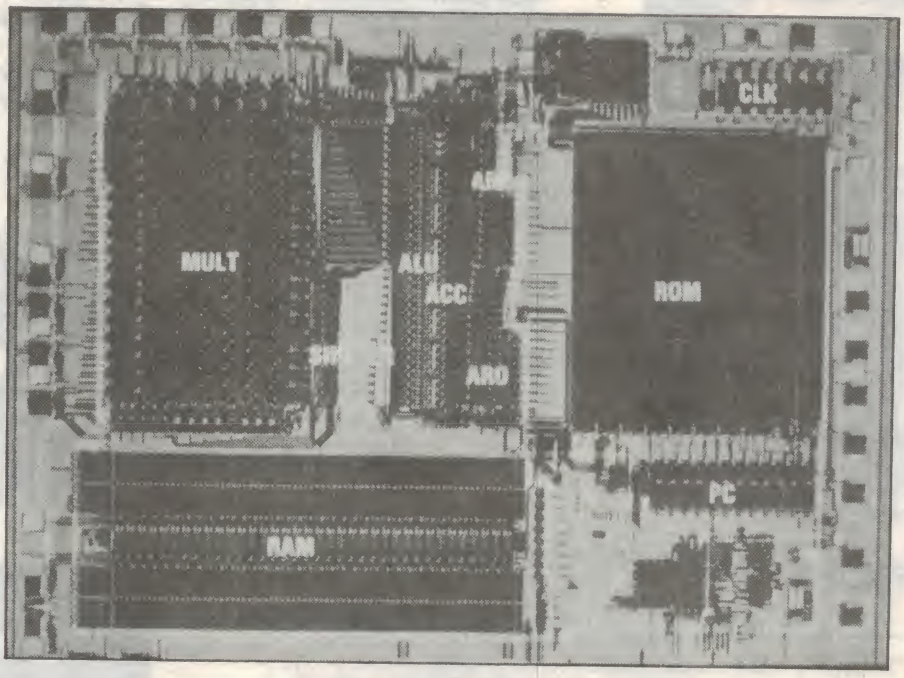
Applications

A typical example of a one chip micro in use is in a modem where it looks after the house keeping functions, dialling and handshaking with the host computer. They commonly provide automation in musical mixing desks, in synthesisers, polyphonic samplers, disco or special effects light controllers, etc. This is a small list only in the music technology area. Other applications include as protocol controllers, in missiles, in intelligent sensors, PABX systems, sophisticated security systems and many more devices.

On the domestic level, one chip micros have already been installed in many electrical appliances such as the washing machine, microwave oven and even in some smart toys. All these applications depend on low cost, small sizes, powerful I/O and dedicated control.

Another fast growing area for one chip micro applications but perhaps less apparent to people is in the automotive industry. Twenty years ago, one would be lucky to find more than five fuses in an average priced car. Today motor cars have fuel injected engines, self-adjustable suspension, anti-skid braking systems, auto-cruising controls, instrument panel displays, etc, all monitored by the one chip micro. The trend will continue. Giant micro chip companies like Intel, Motorola, Texas Instruments, etc, are pushing this vision hard. Cars in the immediate future will have their amount of on-board electronics doubled at least. Climate control, navigation systems, trip computer and integrated alarm systems will be standard features.

Automotive fault finding will change too. Each individual micro looking after a



A TMS32010 chip (courtesy Texas Instruments).

specific function on board will report if a fault develops in the system. In diagnosing the system malfunction, the car mechanic need only plug in an electronic test jig to an easily accessible port to track down the fault within a few seconds.

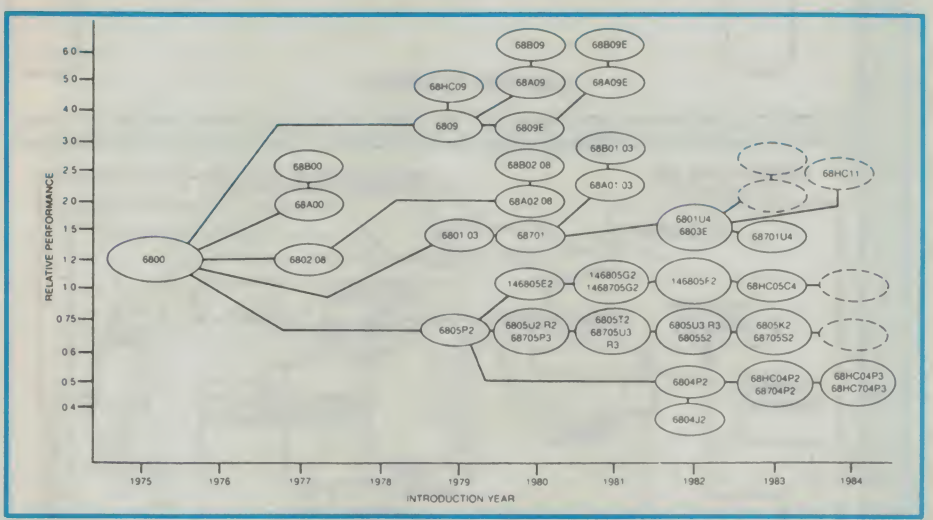
In other areas, a one chip micro is an absolute must. For instance, a good quality robot arm needs one micro to control each motor. Without this arrangement, the host computer would be too busy looking after the speed, position, current and voltage in each motor. With a one chip micro, valuable CPU time can be spent in calculating and controlling the overall movement of the arm.

Architecture and architects

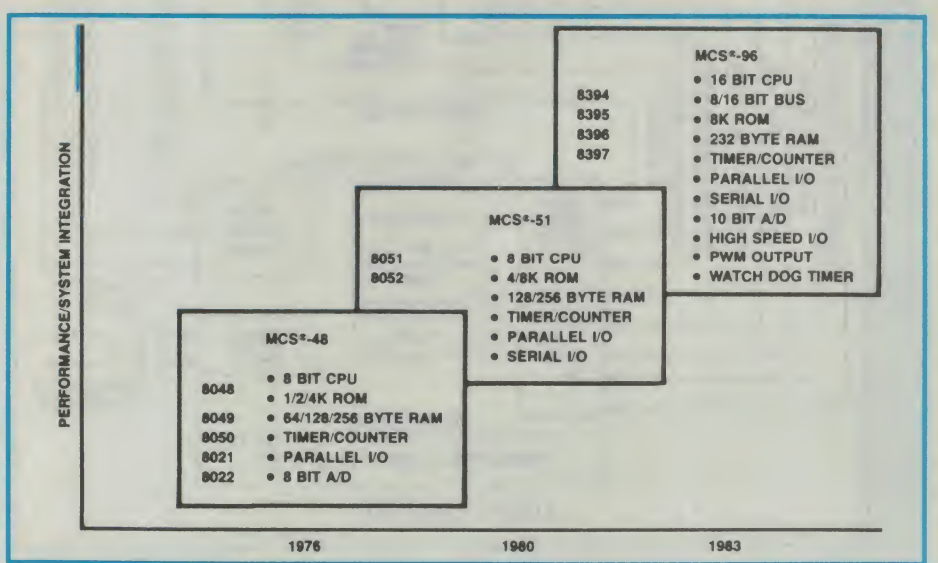
To many of us, intuitively, a single chip micro is no more than a cluster of various existing chips in a discrete package. It's a customized chip with the CPU, RAM, ROM, peripherals, etc, all mingled together in the silicon. This is, in fact, not wholly true. The internal architecture of the one chip micro is usually re-designed specifically for control applications. It has a specialized CPU with dedicated instructions for bit manipulations, much faster and more comprehensive interrrupt responses and more internal registers for convenient looping control in software. The one chip micro also heaps on more I/O ports, timers and other peripherals.

Although micros have all been designed for systems and control applications, different chip manufacturers have taken remarkably different design approaches. But in one thing they are similar. International chip manufacturing giants have all continued developing micros along the same lines as their earlier CPUs, PIAs, etc. This kept their established customers happy with a set of micro instructions similar to the old ones they were used to.

Financially, of course, similar designs are more economic. Manufacturers can cut the cost in R&D by borrowing the core part of the CPU, PIA, UART, etc, from the library, and avoid re-inventing the wheel.



Genealogy of the cohesive M6800 microprocessor/microcomputer family.



Evolution of microcontrollers at Intel.

Intel

Intel has three major families: the MCS-48, MCS-51 and MCS-96. They came out in 1976, 1980 and 1983 respectively. The MCS-48 and 51 are 8-bit systems with 1 to 8K ROM, and 64 to 256 bytes of RAM on board. They usually have parallel I/O and a timer counter as standard features. With the upgraded families such as the MCS-51 and MCS-96, powerful peripherals like serial I/O, high resolution A/D, watch dog timer, high speed I/O and pulse width modulation output are all included in one chip. The latest family, the MCS-96, also has an enhanced internal CPU to handle 16-bit data simultaneously with an 8/16-bit bus.

Two very special features offered by Intel are the bit addressing mode and the two level user program security system. In fact, it is this unique bit addressing ability of the MCS-51 family that makes it more dedicated to control applications than its CPU counterparts.

Most CPUs like the 8080, 6800, etc, have quite a few different types of addressing modes but none capable of dealing with a single bit in an 8-bit word by a single instruction. Conventional CPUs require a single word (8-bit) to be read, then masked with another word to isolate the bit concerned before a decision can be made. This usually requires three instructions, and is too slow and inefficient to be tolerated in many control applications. ▶

Security

To incorporate the micro into a design, a program is needed to determine the behaviour of the chip. It usually takes a fair amount of time and labour to get this software working, so Intel has developed a two-level user program security system to protect it.

It consists of two internal security control bits in the memory of the chip which can be programmed to prohibit the micro from reading or moving the internal code to external memory. It also disables any verifying mode, which might in some cases prove inconvenient. A verifying mode checks on the memory to see if the customized program has been burnt in correctly before shipment, and is essential in a high grade quality control production line. To overcome these contrary requirements, only one internal security bit is programmed, as well as a security table memory.

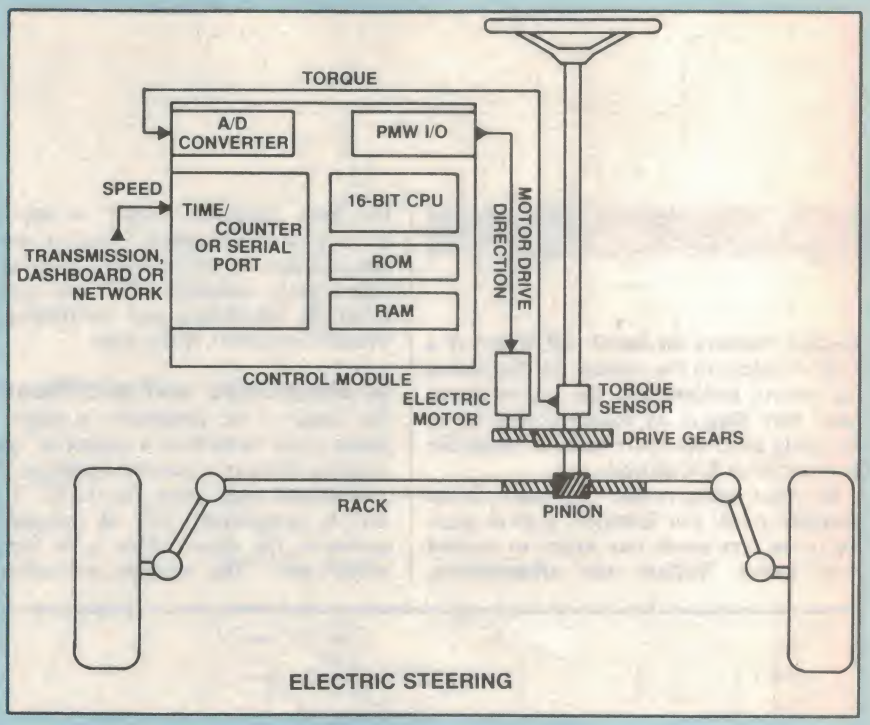
The security table memory is 32 x 8 bits array of memory in the EPROM. The user can electrically program any arbitrary code into it. The code will be used to mask the user program during program verification. Thus what is being read from the micro is a scrambled program which cannot be deciphered without the key security table. Programming the security bits also prevents programming the EPROM and the security table memory, therefore, the security bits must not be programmed before the user program and the security table. Anyone who tries to copy the program illegally must erase the security control bits, but this will also erase the security table and the customized user program leaving the thief with nothing to steal.

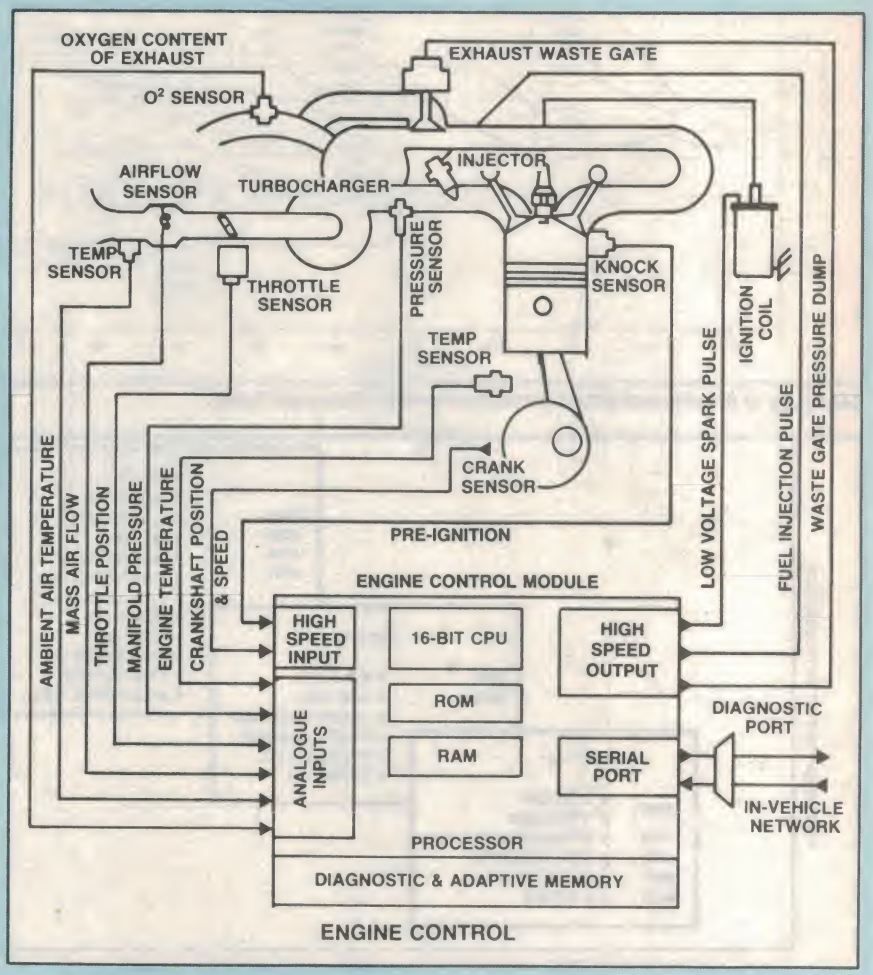
Motorola

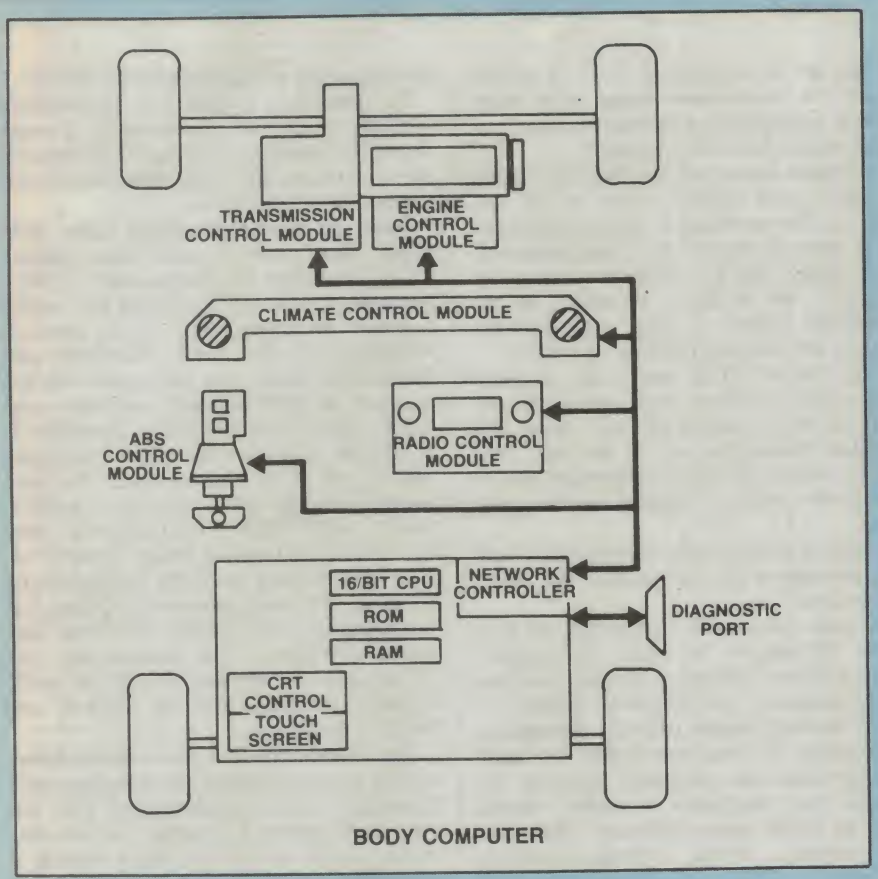
Motorola has a wide range of products in the one chip micro area, offering the M3870, M6801, M6804 and the M6805 families. The M6801 is the throughput leader of the range with 16-bit data operations, binary multipy, and with an average of only 3.7 cycles per instruction.

The masked ROM memory capacities range from 1K byte for the M6805 and the M6804 families up to 4K bytes on the M6801 version. On-chip RAM sizes range from 32 bytes in the M6804 family to 192 bytes in the M6801 family. Peripherals included are pretty much the same as offered on the Intel range: programmable interrupt vector, 8-or 16-bit timer counter, parallel I/O and in the MC6801 family, a full 8-bit UART with buad rate generator on-chip. In the MC6804 family, a few members have a 4-channel A/D converter included and one member has a digital portion of an rf frequency synthesizer added. ▶

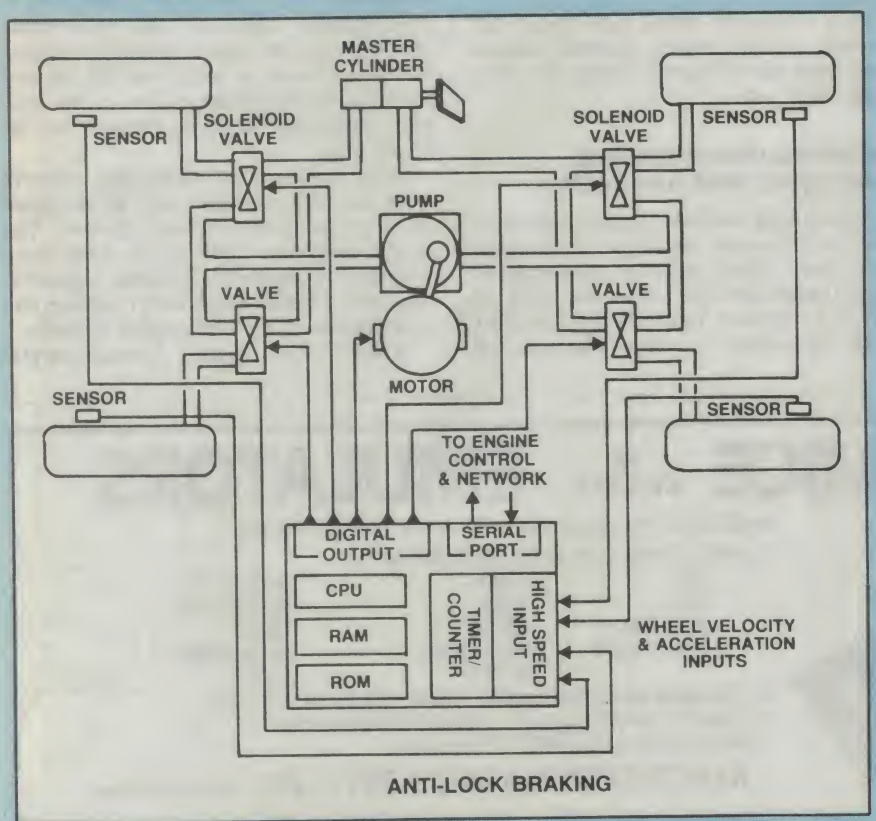
One chip micro applications in automobiles (courtesy of Intel Corp).







BODY COMPUTER



ANTI-LOCK BRAKING

True, our "one-chip" modem doesn't use just one chip.

1200 bps Modem

Controller

Despite the ads, most "one-chip" modems aren't really. Including ours.

You'll actually need two chips from Sierra Semiconductor, our SC11004 modem and its SC11007 controller, to get the complete functions of a full duplex 1200/300 bps integrated smart modem.

But best case, our competition takes six parts!

With Sierra's modem, you'll not only save four chips, you'll get both 212A and V.22 compatibility. As you might expect, you'll also save considerable design work.

SIERRA SEMICONDUCTOR

ETI READER SERVICE 12

Lately, Motorola has been keen to include a low power CMOS version (MC68HC11A4) with EEPROM memory to replace the traditional ROM and EPROMs. The EEPROM is most suited to the automotive applications cited earlier. Data can be written into and read from the EEPROM just like RAM when there is power supplied. Data is automatically saved even without the supply when the engine has turned off. A further advantage offered by the EEPROM over RAM is that it requires higher voltage to write data than RAM. Thus it gives higher noise immunity against spikes and noises generated by the engine and dynamo to the program stored in EEPROM.

Texas Instruments

Texas Instruments is another one chip micro manufacturer with 8-bit TMS7000 and 32-bit TMS32010 families. Like the Motorola and Intel series, the TMS7000 family offers plenty of I/O pins, up to 12K bytes of ROM, three timers and a complete UART on TMS70X1 versions.

Although the family does not provide bit addressing capability, it has eight powerful addressing modes to handle indexed, indirect calls and register-to-register arithmetic. Five levels of interrupt priorities and capability of external pulse width measurement and modulation have put Texas Instruments' TMS7000 series in a fairly competitive position in the market.

TI has recently knocked out a CMOS version with more features. A standard NMOS TMS7742 has only 4K bytes of EPROM, three timers and a serial port. The new CMOS TMS77C82 has 8K bytes of EPROM and 256 bytes of RAM plus all the other standard peripherals on-chip, putting itself in a very challenging position against the Motorola MC68HC11, which is also a CMOS chip. The 32-bit TMS32010-14 is probably the top model of the range. It can act as a standard CPU, a co-processor or stand-alone single chip micro with a multiplication instruction that executes within 280 nanoseconds!!

A unique feature of the TMS7000 family is micro code control. Most of the one chip micros mentioned above implement their internal control by a programmable logic array (PLA). Therefore, their instruction set is fixed. However, in the TMS7000 family, a user programmable control ROM is used instead of a PLA.

The control ROM has a set of micro codes burnt in before shipment which control internal operations and form the standard instruction set of the chip. The direct benefit of this arrangement lies in the user's ability to reprogram the micro code.

Thus, it is possible to modify the standard instruction set to optimize the user's application.

A user customized instruction set provides advantages of faster throughput, more efficient utilization of user program ROM memory, and improved system security through unique software algorithms. The ability to remicroprogram the code also provides an alternative solution for designs that encounter a critical timing loop or ROM space limitation. Remicroprogramming avoids system hardware redesign.

Other companies which have their own one chip micros include General Instruments with its PIC series, Zilog Z8, ZS8, Sharp, NEC, etc.

Software development, debugging and emulation

The many long internal registers and integrated architectural structures on one chip micros have made software development almost impossible without some kind of tool. The different tools can be classified briefly according to their functions of development, debugging and emulation.

To develop a program, a development tool like an assembler is essential. It transforms the assembly instructions written by the user to machine code which can be executed by the micro chip.

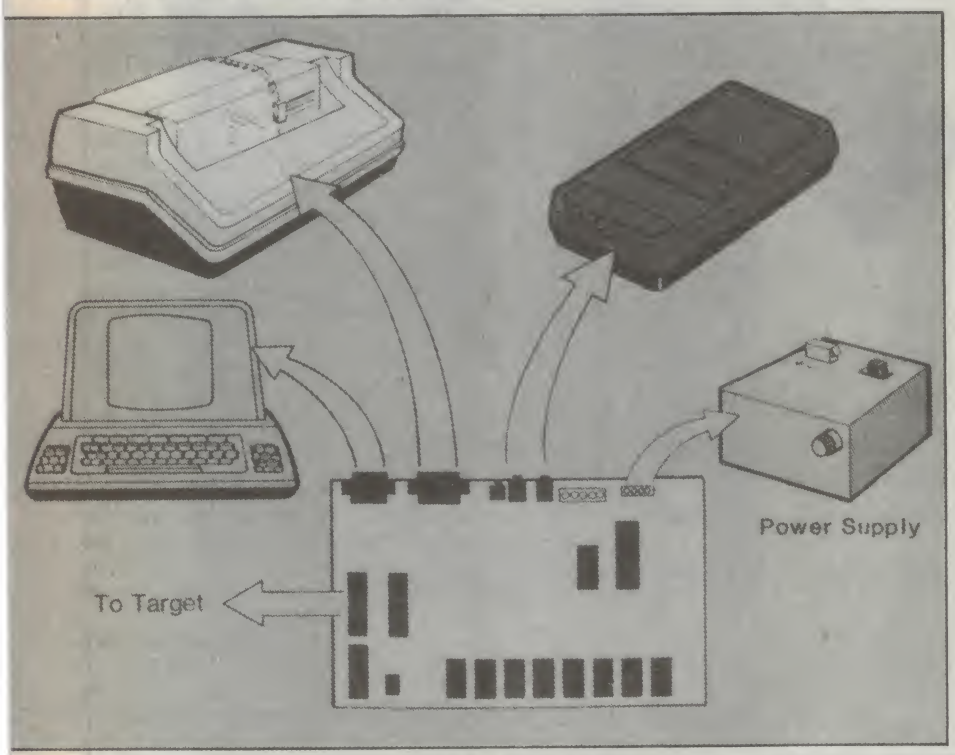
Although assembly language is one level higher thus easier to use than machine code, it requires the programmer to think in terms of flags, carry out and bits, which is pretty tiresome. Many of the cross-assemblers for the Intel, Motorola and Texas Instruments one chip micro families can run on IBM personal computers and VAX. Apart from assembling assembly instructions, they also use higher languages like C and PLM. For instance, the Intel MCS-51 family has a PLM-51 compiler; others use PLM-80 or PLM86 for their corresponding families which compile instructions written in PLM (programming language for microprocessor) making the programmer's job easier since the language is portable. The programmer uses the same set of instructions in PLM (or C) to write programs for the MCS-48 and MCS-51 families.

The machine code is then usually downloaded to the emulator for debugging and emulation. The emulator plugs into the user target system to emulate the one chip micro, so as far as the target system is concerned, the emulator is transparent. It does exactly what the one chip micro would do to the target system but allows the user to look at what's in the internal registers, setting break points in the program and single stepping through the instructions.

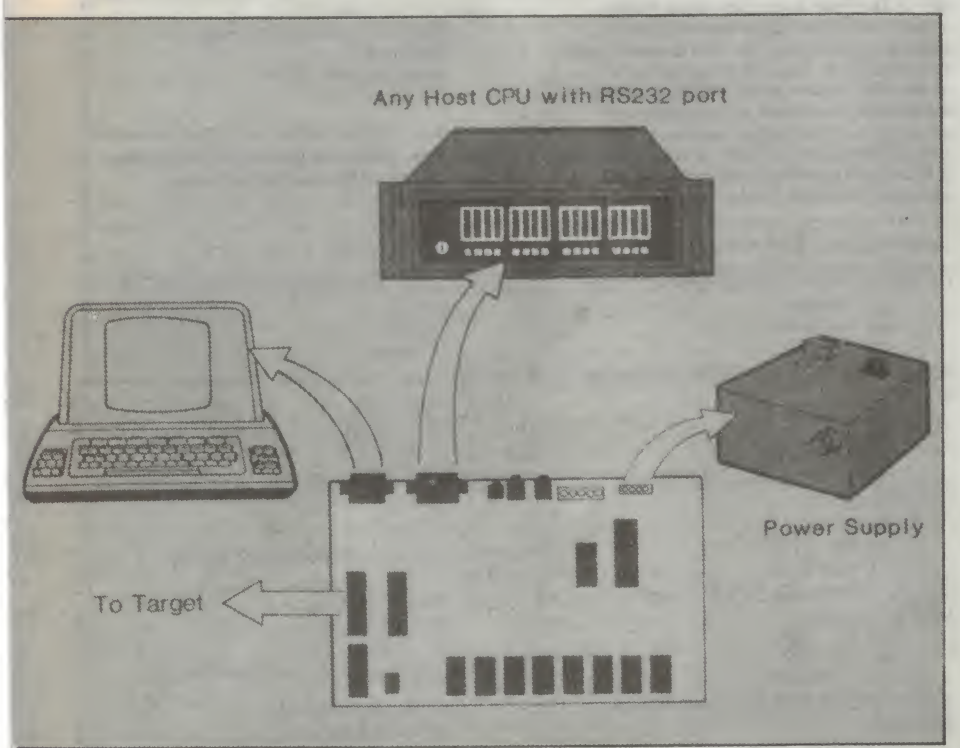
Some sophisticated debugging software tools are only symbolic, and an emulator and a target system are not required. Top of the range are tools to do logic state analysis on symbolic internal registers, data and address buses or to analyse the performance of the user written software.

Besides the original manufacturers, ▶

Texas Instruments TMS7000 family evaluation board.



STAND ALONE MODE



PERIPHERAL MODE

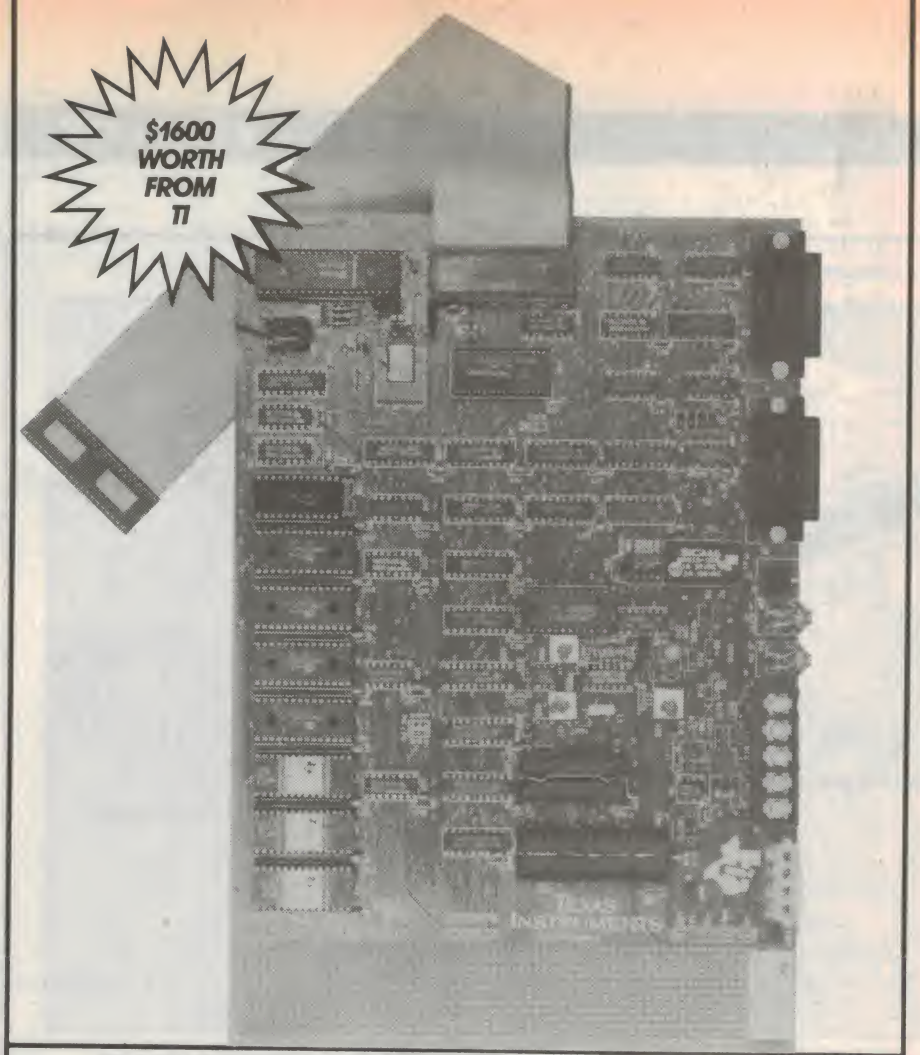
there are quite a few companies around like Philips Scientific & Industrial in NSW, Daneva and Macro Dynamics in Victoria, and Baltec Systems in Queensland, which supply a fleet of development systems, emulators, and stacks of software tools to back up the application software development.

Production limitations: economics

Mentioned above are the facilities we can get in the one chip micro at present. What is the outlook for the future? Surprisingly, the most important limiting factor on what can be put onto a chip is not the availability of technology, rather it's the economics. Two hundred normal size chips could easily be masked on a single die these days, so in theory, what's stopping a massive chip-per-die 200 times bigger? The answer is the price of the chip, which depends very much on the yield. If the price of a chip was immaterial, it would be possible to produce a one chip micro with everything you could dream of on it. But the production process is your limitation. On a die of 200 normal size chips, if two per cent fail that leaves 196 working ones available for sale. With a massive chip 200 times bigger, it only takes one faulty transistor somewhere in the chip to turn it into a complete dud. And the chance of having faulty transistors rises sharply with the size of the chip. Nevertheless improvements continue apace towards a much bigger and purer silicon bar with sub-micron technology and higher yield.

It is not always true that the price of a chip is directly proportional to its size. Compare the price and size of a $5 Z80 CPU chip with a smaller but more expensive 74C926 4-digit 7-segment decoder driver if anyone has doubts about it. There are many factors determining the price of a chip: market demand, yield, the degree of difficulty of the process. Size is a relatively insignificant determinant, though these factors are interrelated.

When CMOS was first introduced the price was high, which reflected the fact that the CMOS process was considerably more complex than TTL. But the many advantages of CMOS over TTL were soon realised and sales of CMOS began to rise sharply. As the CMOS market started to grow, so was the money pumped back to R&D to ensure higher yield, lower cost CMOS process. Now, the price for CMOS is much lower. If the same sequence occurs with one chip micros it is possible that customers will be able to order a batch of chips with their internal architecture and I/O capability designed exactly the way they want — in much the same way as they now supply artwork for producing a customized pc board. ●



ETI-TEXAS INSTRUMENTS ONE CHIP MICRO COMPETITION

Win a TMS7000 one chip micro family evaluation board by answering the following questions. The first correct entry drawn will win the Texas Instruments evaluation board worth $1600, capable of assembling software, debugging and emulation in the target system, and programming the EPROM. It interfaces with a standard personal computer, data cassette recorder and a printer.

Send your answers to:
ETI-Texas Instruments Comp,
PO Box 227,
Waterloo, NSW 2017.

The competition will be drawn 10 October 1986, by David Cartwright of Texas Instruments.

Questions: Mark your answer by circling or ticking the appropriate choice.

(1) The 8-bit microcomputer family is called:
(a) TI8000
(b) TMS7000
(c) TMS800

(2) The new TI CMOS EPROM microcomputer is called:
(a) TI77E42
(b) TMS77C42
(c) TMS77C82

(3) How much on-chip EPROM does the TMS7742 have:
(a) 2K bits
(b) 4K bytes
(c) 4.2K bytes

(4) How much on-chip EPROM does the TMS77C82 have:
(a) 8K bytes
(b) 8K bits
(c) 8.2K bytes

(5) The TMS77C82 is fabricated in which technology:
(a) CMOS
(b) ECL
(c) NMOS

(6) How many timers does the TMS7742 have:
(a) one
(b) two
(c) three

(7) How much on-chip RAM does the TMS77C82 have:
(a) 256 bytes
(b) 128 bytes
(c) 256 bits

(8) Does the TMS7742 have a serial port:
(a) Yes
(b) No

(9) The TI 32-bit microcomputer family is called:
(a) TMS32020
(b) TMS32010
(c) TI33000

(10) The TMS32010-14 does a multiply instruction in:
(a) 280 nanoseconds
(b) 1400 nanoseconds

MIDI MATRIX

Behind every orderly studio stands a MIDI matrix. If you want to clean up your recording act or are just interested in MIDI products this project should put you straight.

Neale Hancock

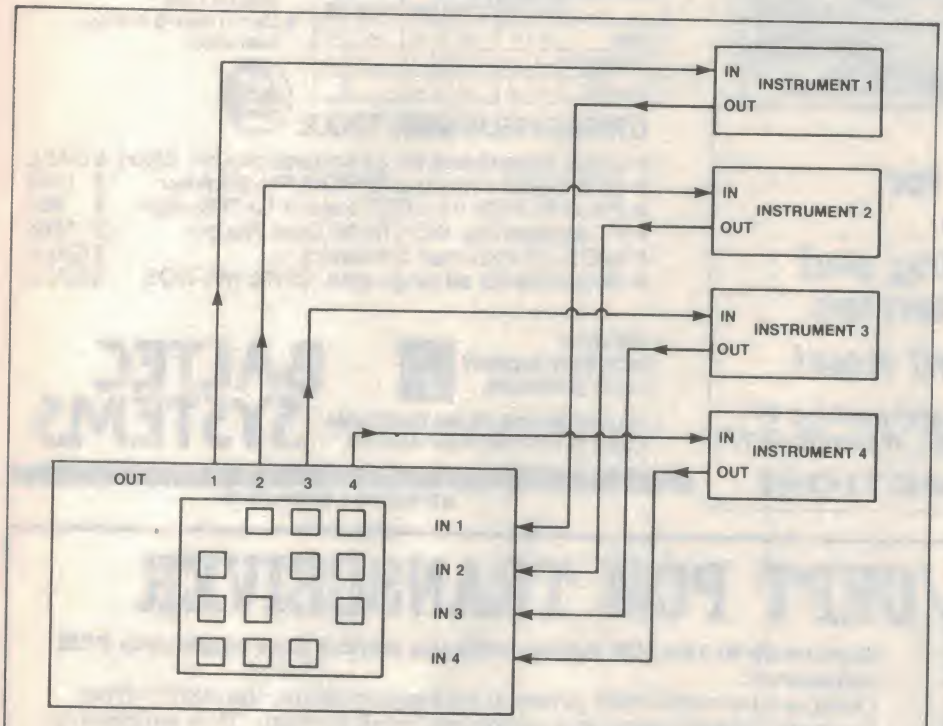


Figure 1. MIDI matrix system configuration.

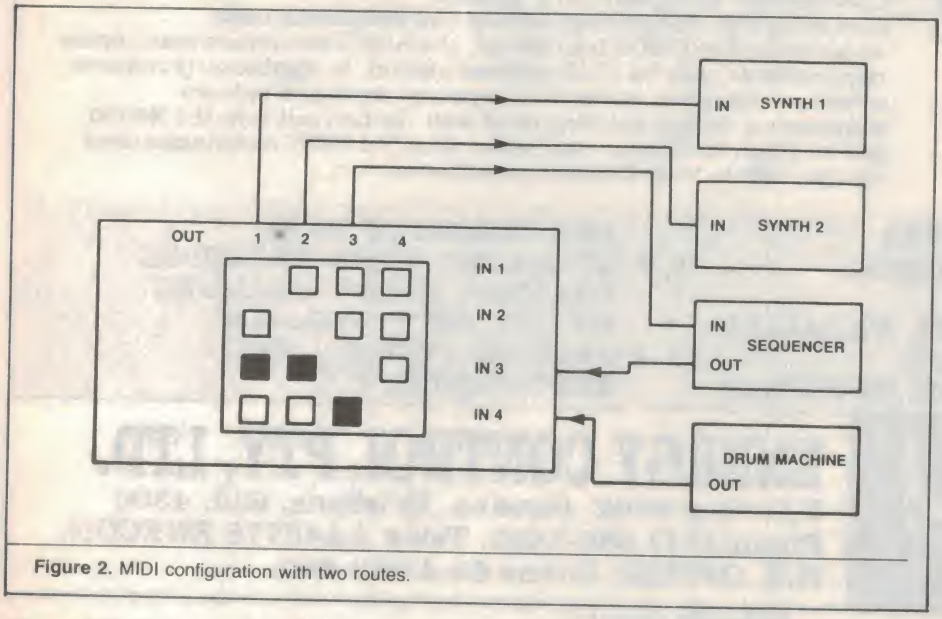


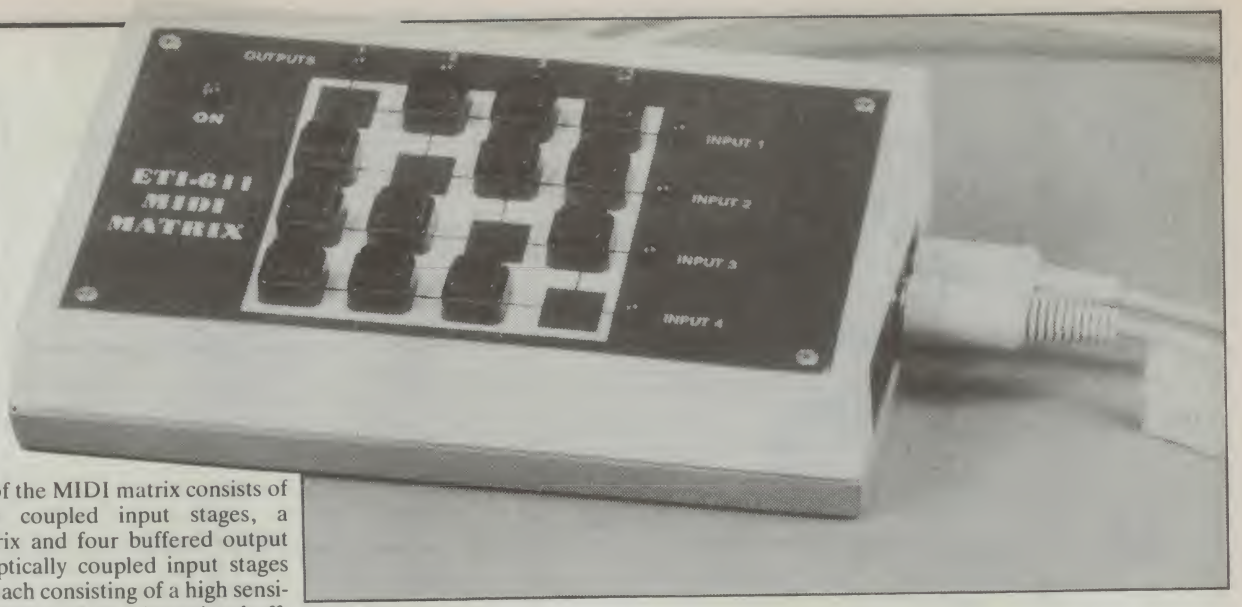
Figure 2. MIDI configuration with two routes.

THE MIDI THRU BOX (project 609) which appeared in the March '86 ETI issue marked our debut into the world of MIDI. That project eliminated the need to connect synthesisers together via the MIDI thru socket, thus solving the associated timing problems. The thru box will suffice if the MIDI system has only one master and many slaves (on "masters" and "slaves" see my article about MIDI next issue). However, when the MIDI bug has got you and you have more than one master in the system, there's a danger you can spend more time plugging and unplugging MIDI cables than actually making music. To save our readers from traumatic nightmares fighting through jungles of MIDI cables while trying to emulate the latest New Order single, here is the ETI MIDI matrix to solve MIDI patching woes.

Outputs from any MIDI unit, be it a sequencer, a synthesiser or a drum machine, can be sent to the input of any other MIDI unit via the matrix. This re-routing of inputs and outputs can be achieved at the push of a button, thus eliminating the hassle of swapping MIDI cables when a different set-up is required. Figure 1 shows a typical set-up in which the MIDI matrix re-routes information from any input to any output.

The MIDI matrix permits synthesisers, sequencers and drum machines to send and receive information in two main ways. One way is to set up the matrix so that the output from one master is sent to three slaves. This permits the MIDI matrix to act as a thru box with switch-selectable inputs.

The matrix can also be configured to allow two routes of MIDI information to pass through it. For instance, if you have a set-up where there is a sequencer, a drum machine and two synthesisers, you can switch the MIDI OUT from the drum machine to the MIDI IN of the sequencer, then switch the MIDI OUT from the sequencer to the MIDI INs of the two synthesisers. All of these connections are performed by pushing only three buttons. This set-up allows the drum machine to send synchronization information to the sequencer as well as allowing the sequencer to play the synthesisers. Figure 2 shows the set-up diagramatically, simplified so only the relevant signal paths are shown. The buttons to be pushed to connect the signal paths are shown with darkened squares.



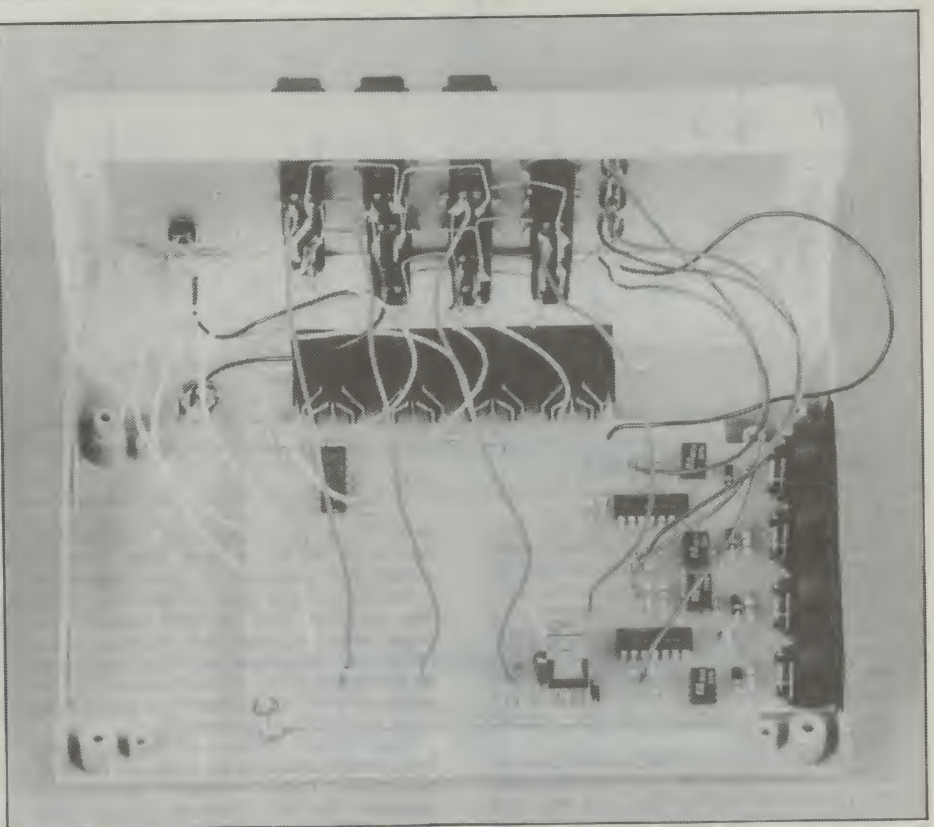
The circuit of the MIDI matrix consists of four optically coupled input stages, a switching matrix and four buffered output stages. The optically coupled input stages are identical, each consisting of a high sensitivity optocoupler and two inverting buffers. Since MIDI information is transmitted and received via a 5 mA current loop the input stage requires an optocoupler to convert the incoming current pulses to voltage pulses. The optocoupler used in this project is a Hewlett-Packard 6N138 as recommended in the MIDI specification 1.0.

The two inverting buffers mentioned above are connected in parallel. One of them drives the indicator LED, and the other buffers the signal before it goes into the matrix. The reason for buffering the signal before it goes to the switching matrix is to save the optocoupler from having its output excessively loaded.

The switching matrix allows the signal from any of the input stages to be switched to any of the buffered output stages. The rows of the matrix carry the signals from the input stages and the columns of the matrix carry information to the output stages. The rows and columns are connected by pushbutton switches at the cross points. For instance, by depressing the pushbutton switch at the intersection of row 1 with column 2, input 1 will be connected to output 2.

Each of the four output stages has two inverting buffers connected in parallel. One of the buffers drives the output indicator LED and the other buffers the output signal. The output signal is re-inverted by this buffer to compensate for the inversion of the input signal by the input buffer. The re-inverted and buffered signal is then sent to the 5-pin DIN MIDI output socket.

Below: Interconnections inside the box.



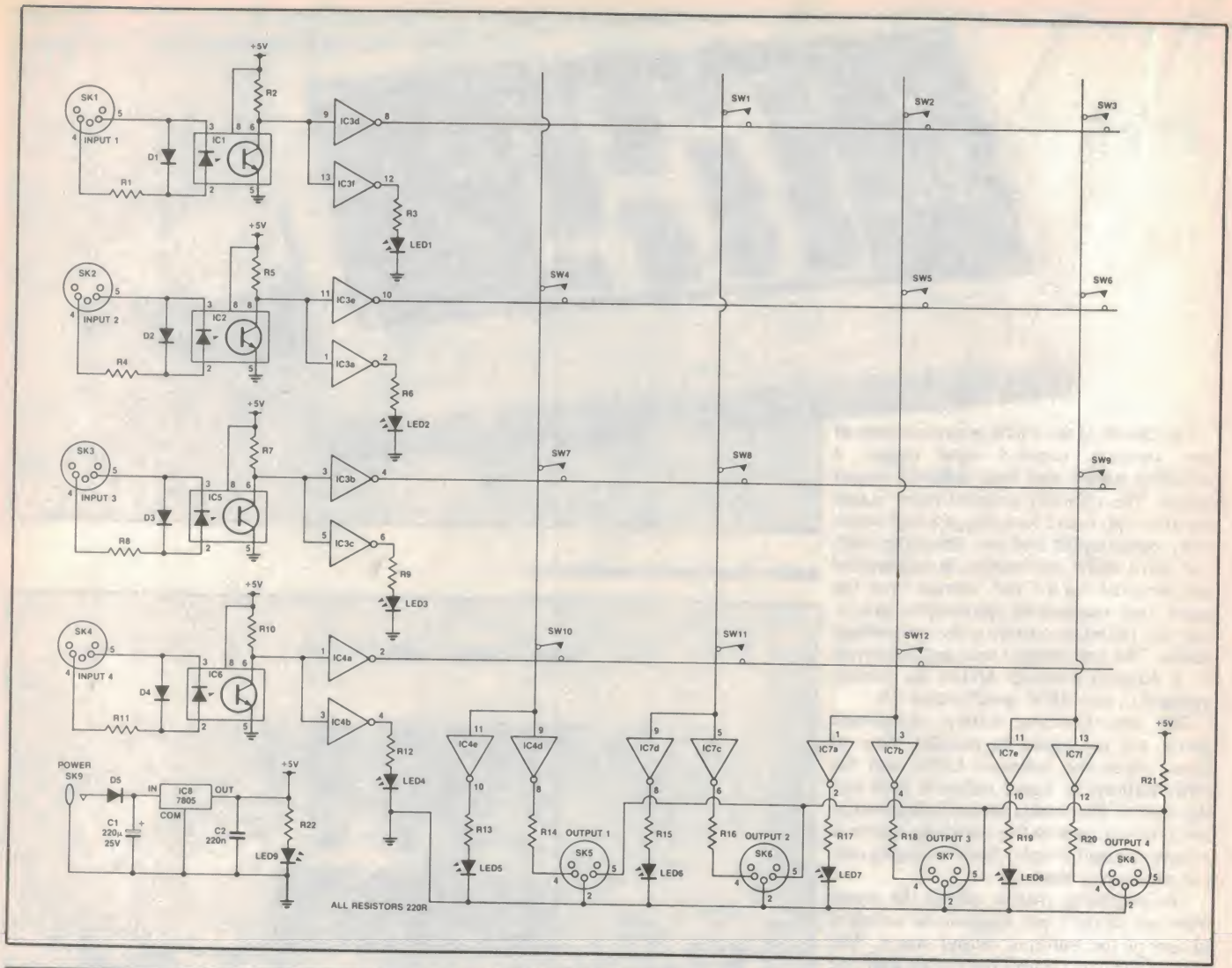
Construction

Before you do anything with regards to the construction of this project, you will have to decide what sort of case you are going to put it in. This is advised because the pc board needs to be cut differently to fit different cases. The case which I used was the console case sold by Rod Irving Electronics, however, the pc board will also fit into a zippy box. I chose the Rod Irving Electronics case mainly for its aesthetic qualities, but I must add that the plastic which it is fabricated from is much easier to work with than the plastic used to make zippy boxes. It's easier to cut the slots required for the DIN sockets in the Rod Irving Electronics case than cut slots in the side of a zippy box.

When you have decided on the case, cut the pc board accordingly. If you decide on the Rod Irving Electronics case, use a hacksaw to cut along all the dotted lines on the pc board. If the thought of hacking into your pc board like that gives you a churning sensation in your lower abdomen, you can play safe by cutting the board a few millimetres outside the dotted line and filing the rest. If you decide to mount the MIDI matrix in a zippy box, cut only the corner where "ETI-611" appears. The zippy box will need to have one of its pillars removed.

Have a break?

Now that you have remodelled the pc board, check it for broken or bridged tracks. If you find any tracks that are broken they can be repaired by soldering a short length of wire across the break. When repairing broken tracks, start by melting ▶



ETI-611 — HOW IT WORKS

Each input stage consists of an optocoupler, two resistors, two inverting buffers, a diode, an LED and a 5-pin DIN socket, which is a standard input stage for MIDI equipment. For input 1 these components are IC1, R1, R2, R3, IC3d, IC3f, D1, LED1 and SK1. For input 2 they are IC2, R4, R5, R6, IC3d, IC3e, D2, LED2 and SK2. The corresponding components for inputs 3 and 4 are easily recognized on the circuit diagram.

The signal from the MIDI current loop enters the circuit through SK1 and the diode, D1, protects the optocoupler, IC1, from the possibility of this signal having a reverse polarity. IC1 enables the current loop to transfer data to the inverting buffers (IC3d and IC3f) without any electrical connection to the circuit. Optically coupling the current loop to the rest of the circuit permits the loop and the circuit to be electrically isolated. Since there is no connection with an electrical ground anywhere in the loop, current loops are practically immune to earth loops and other sources of hum.

The output from the optocoupler is sent to two inverting buffers connected in parallel. Buffer IC3d inverts the signal and sends it to the switching matrix. This buffer can drive up to eight TTL loads. This permits one input signal to drive three outputs. Buffer IC3f receives the same signal as buffer IC3d and is used to illuminate LED1. The switches SW1 to SW2 connect the cross points of rows and columns in the matrix and thus allows any input module to be connected to any output module. For instance, if SW1 is depressed the signal from input 1 is switched to output 2.

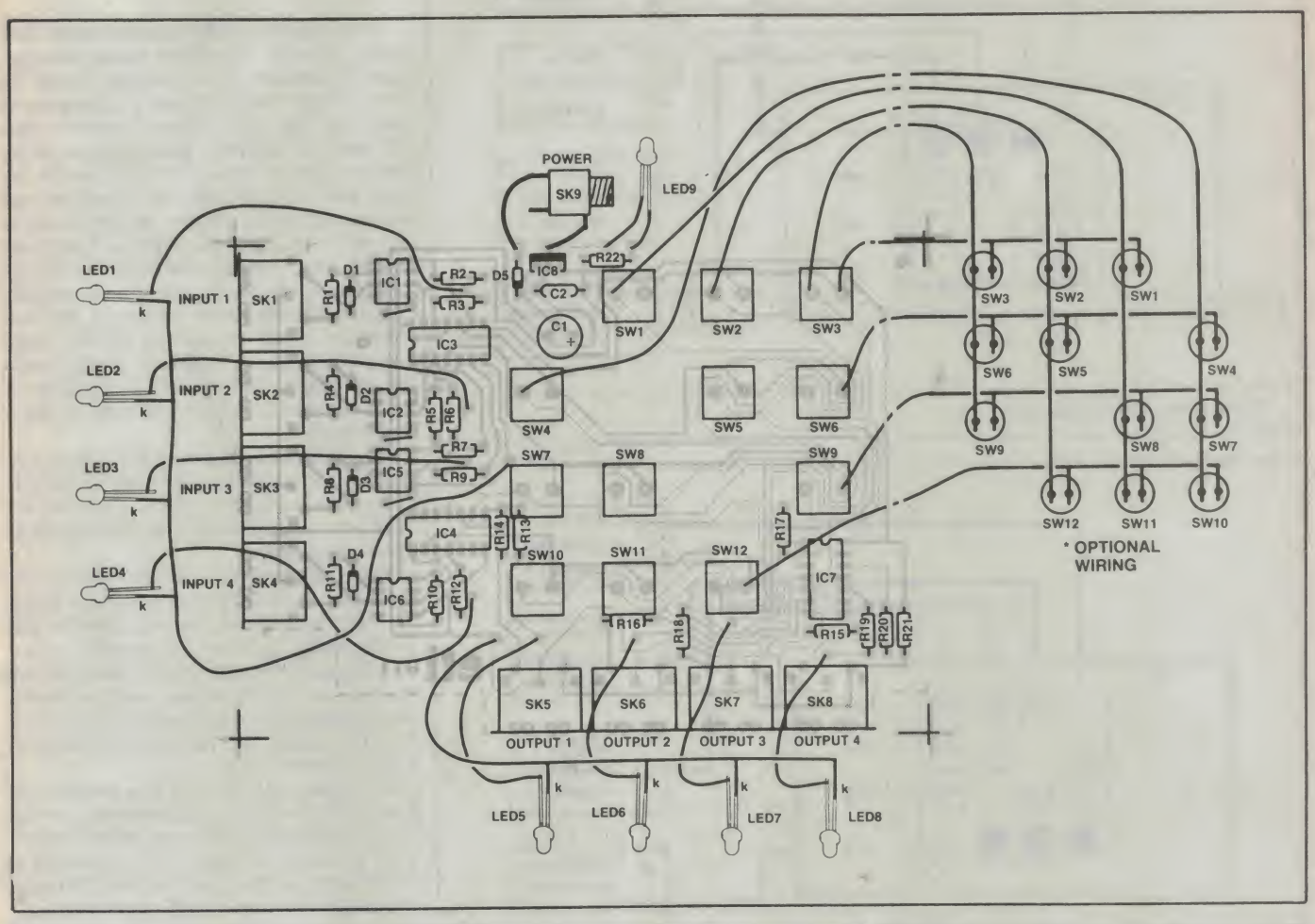
Each output consists of two resistors, two inverting buffers, an LED and the output socket. Output module 1 consists of resistors R13, R14, inverting buffers IC4d, IC4e, LED5 and output socket SK5. When inverter IC4d has a signal from the input stage switched to it via the matrix, it re-inverts this signal, to its original form. The output from IC4d is sent directly to SK5, which is the MIDI output socket. Buffer IC4e is used to illuminate LED5.

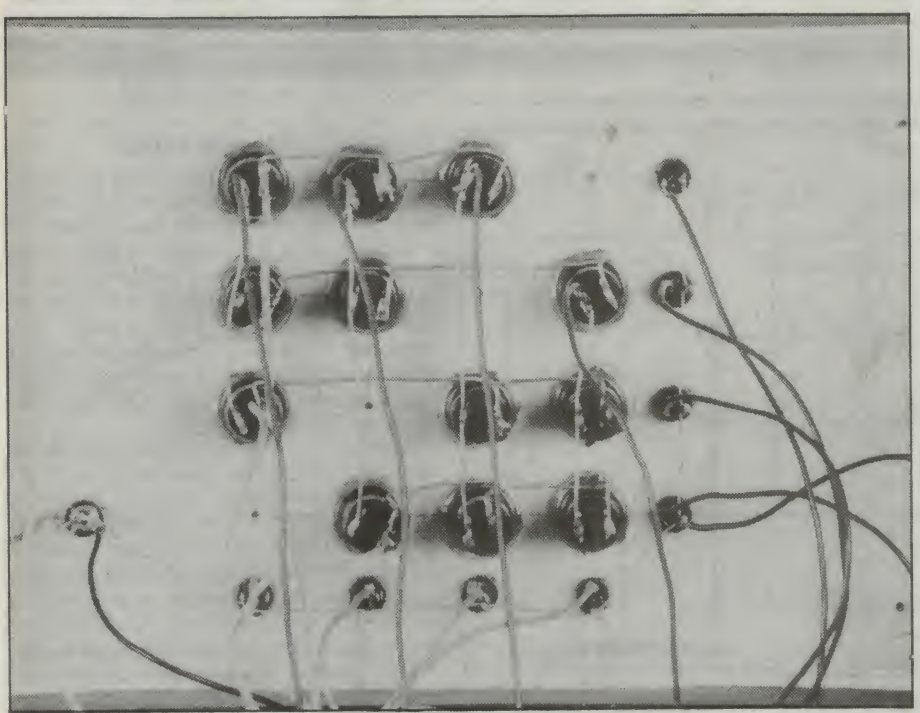
The source of power is derived from a plugpack or a 9 V battery and D5 protects the circuit against a reverse polarity being applied from either of these. Capacitors C1 and C2 protect the circuit from power supply irregularities. IC8 is a voltage regulator, which provides a 5 V output to the rest of the ICs.

solder onto either end of the break, also melt some solder onto the wire. By melting solder onto the pc board and onto the wire it makes it easier to solder the link to the board. Place the link on the break and heat it with a soldering iron until the solder melts. If any of the tracks are bridged, cut the bridge away with a scalpel or a similarly sharp implement.

After examining your board and repairing any faults, you can start assembling. Begin by soldering in the three links, these are located near IC1, IC2 and IC5. Mount the eight sockets, (four input and four output) and the resistors. The diodes can now go in along with the capacitors, but since these components are polarised, check their orientation against the component overlay first. Next solder in all the ICs, but be sure to check their orientation as well.

There are two ways of mounting the switches. Both ways are shown on the component overlay. Before you mount them, make sure that they are all first switched off, thus saving yourself some hassles when testing the unit. To check that they are turned off, test for continuity between their lugs. If there is continuity push the switch until you hear it click off. ▶





ETI-611 — PARTS LIST

Resistors.....all 5%, ¼ W
R1-22 .....220R
Capacitors
C1.....220µ 25 V electro
C2.....220n
Semiconductors
D1-5 .....1N4004
LED1,4,9 .....red
LED5-8 .....green
IC1,2,5,6.....Hewlett-Packard 6N138 optocouplers
IC3,4,7.....74LS04 Hex inverters
IC8.....7805 voltage regulators
Miscellaneous
SW1-12 .....push on/push off single throw switches
SK1-8 .....pc mounting 5-pin DIN sockets
SK9 .....3.5 mm phono socket
ETI-611 pc board; case (see text); Scotchcal front panel; hookup wire; 0.8 mm (or 22 SWG) tinned copper wire.

Price estimate: $70-$80

For a guide to components and kits for projects, see SHOPAROUND this issue.

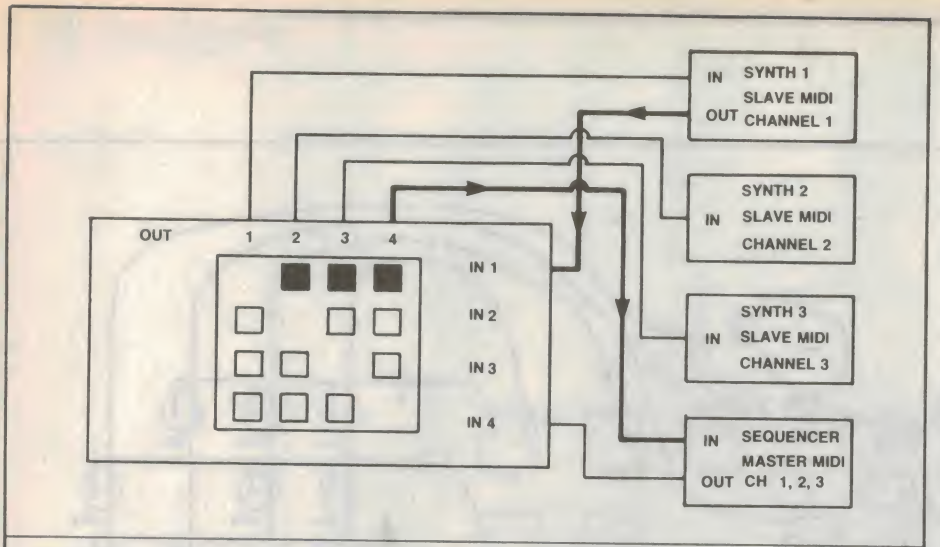


Figure 3. Recording configuration.

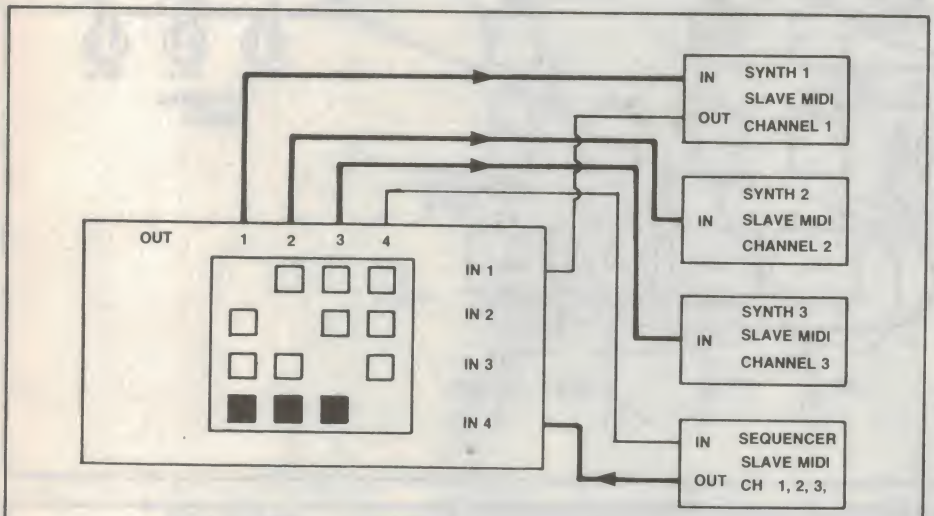
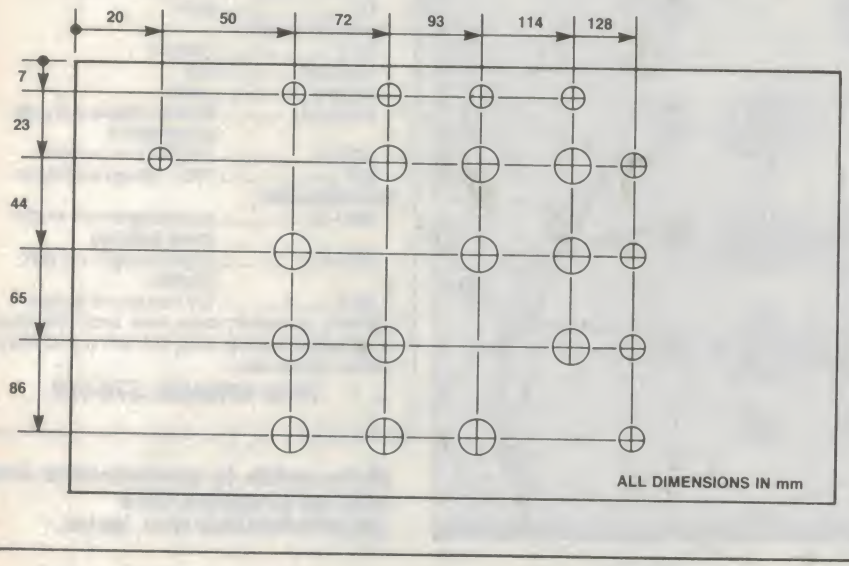


Figure 4. Playback configuration.



If the project is to be mounted in the Rod Irving case the alternative wiring arrangement illustrated on the overlay should be used. When using this wiring arrangement you can link the switches together with 0.8 mm (or 22 SWG) tinned copper wire, but be sure to mount the switches in the case first. The switches are linked in this way to reduce the number of flying leads to the pc board. After the switches have been linked, they can be connected to the pc board as shown on the component overlay.

By soldering short leads of 0.8 mm diameter tinned copper wire to their lugs, the switches can be mounted directly onto the pc board. This mounting technique is recommended for those who wish to use a zippy box.

The only remaining thing to be done is to connect the LEDs and the power socket to the pc board via flying leads. To make the wiring neater, try to keep the flying leads as short as possible.

With this project a MIDI cable is required for every input and output, so if you have four instruments you will require eight MIDI cables. To save you spending excessive amounts of money (up to $20 each) on ready-made MIDI cables, you can make them yourself for much less (about $3 for a 2 metre cable); they are almost as easy to make as guitar leads.

To make a MIDI cable, you require two 5-pin DIN line plugs and two metres of twin core shielded cable. The rear view of a DIN plug is shown in Figure 5. To make up a MIDI cable connect pin 4 of one DIN plug to pin 4 of the other using one of the insulated cores, and connect pin 5 to pin 5 using the other insulated core. The shield which goes around the two cores is used to connect pin 2 to pin 2 on the DIN plugs.

Testing and operation

Before you apply power to the pc board, examine it for shorted tracks and dry joints. Both of these problems can be rectified with a soldering iron. To remove a short from between tracks just run a soldering iron between them. This should melt the solder between the tracks and push it away. Dry joints can be fixed by reheating the solder joint and applying a little more solder. This should be enough to establish a link between the track and the lead.

When you power up the MIDI matrix do not have anything connected to it. Upon applying power, the LED labelled ON should light up. If it doesn't, turn the power off and re-check the pc board and wiring. None of the other LEDs will light up when power is applied providing that none of the switches are on, (this is why I suggested that you switch them off before you solder them in).

The switches are arranged in four columns and four rows, with three switches in each row. The inputs come in the rows and

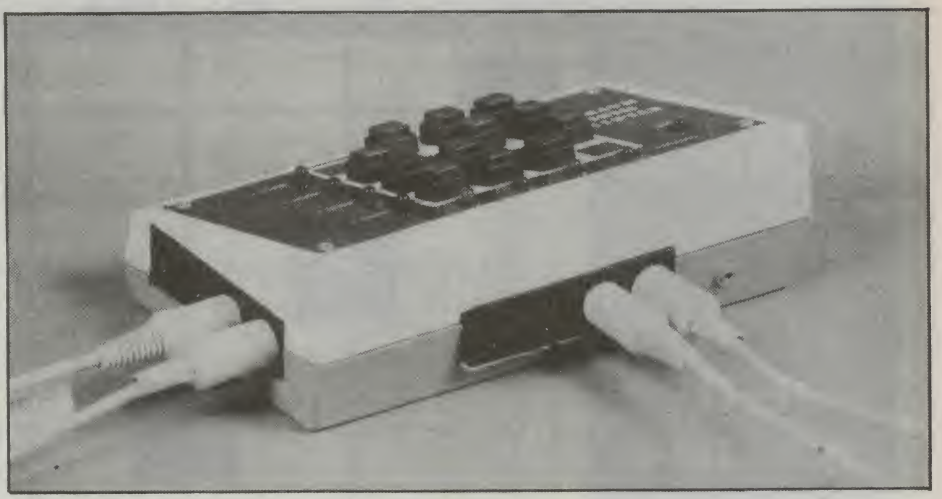
the outputs go out of the columns. If you press any of the switches in the columns, the LED at the top of that column will light up; this indicates that an input has been connected to that column. For instance if you press the switch in the bottom left hand corner, then the LED at the top of that column (indicating output 1) will light up. This means that data from input number four will be sent to output number 1.

Now connected your prized MIDI synth to input 4 of the MIDI matrix. The LED labelled input 4 should flash slightly; this is the MIDI clock information being transmitted. When you press a key on your keyboard the LED should light up at the same time. The reason why there is no switch in the bottom right hand corner of the matrix or along the diagonal, is to prevent an instrument sending MIDI information back to itself. If a MIDI instrument receives its own information while receiving information from another source, the poor thing will probably get confused.

If you have an instrument plugged into input 4, its output data can be switched to outputs 1, 2 or 3 by pressing the corresponding button in the row. When this is done the LEDs corresponding to these outputs will glow. If all three buttons are pressed, outputs 1, 2 and 3 all receive the same MIDI message. This makes the MIDI matrix behave the same way as a MIDI thru box. To indicate that all three outputs are connected, all three output LEDs will glow.

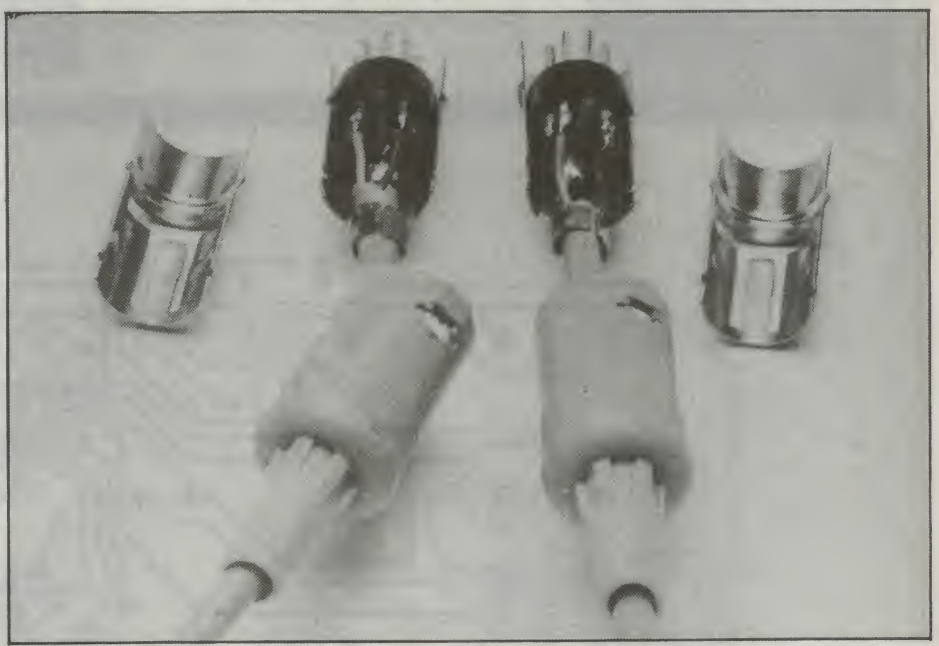
To create two routes through the MIDI matrix (as shown in Figure 2) first connect up all the inputs and outputs from your MIDI equipment to the MIDI matrix. Next push the buttons indicated by a darkened square. The output from the drum machine will be sent to the sequencer and the output from the sequencer will be sent to the synthesisers. In this configuration the tempo of the sequencer is controlled by the drum machine and the music to be played on the synthesisers is sent by the sequencer. This set-up is most useful if you have a computer sequencer that requires its tempo to be set from the computer keyboard and you have a tempo knob on your drum machine. With this arrangement tempo can be controlled by simply turning a knob.

With the instruments connected to the MIDI matrix, life is made much easier than when using a real time sequencer. To write layers of music to the sequencer with this set-up, the MIDI output from the master synthesiser goes to the MIDI input of the sequencer and the slave synthesiser connected to the relevant MIDI channel. Figure 3 shows how the MIDI matrix should be configured for this set-up; the bold lines show the flow of information with this arrangement. Different layers of music can be written from the master keyboard to sequencer and the slave synthesisers, using a different MIDI channel for each layer.



Above: View of rear and side sockets, and plugs.

Below: Pin connections using DIN line plugs and twin cone shielded cable.



When the layers of music are to be played back on different synthesisers, the MIDI output from the sequencer is connected to the MIDI inputs of the three synthesisers using the set-up shown in Figure 4. In this set-up the roles of the sequencer and synthesiser 1 are reversed, so that the sequencer is the master and synthesiser 1 is the slave.

One thing to remember: some MIDI instruments do not appreciate having their MIDI inputs plugged into an output on the matrix which has nothing connected to it. To prevent such problems, make sure that the output connected to the master keyboard has its LED illuminated. This can be done by switching any input to it and since the master keyboard is the only instrument in the system which is sending data, no confusion will ensue.

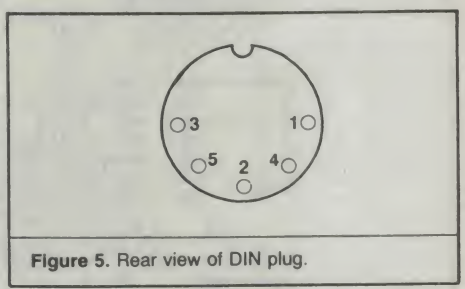
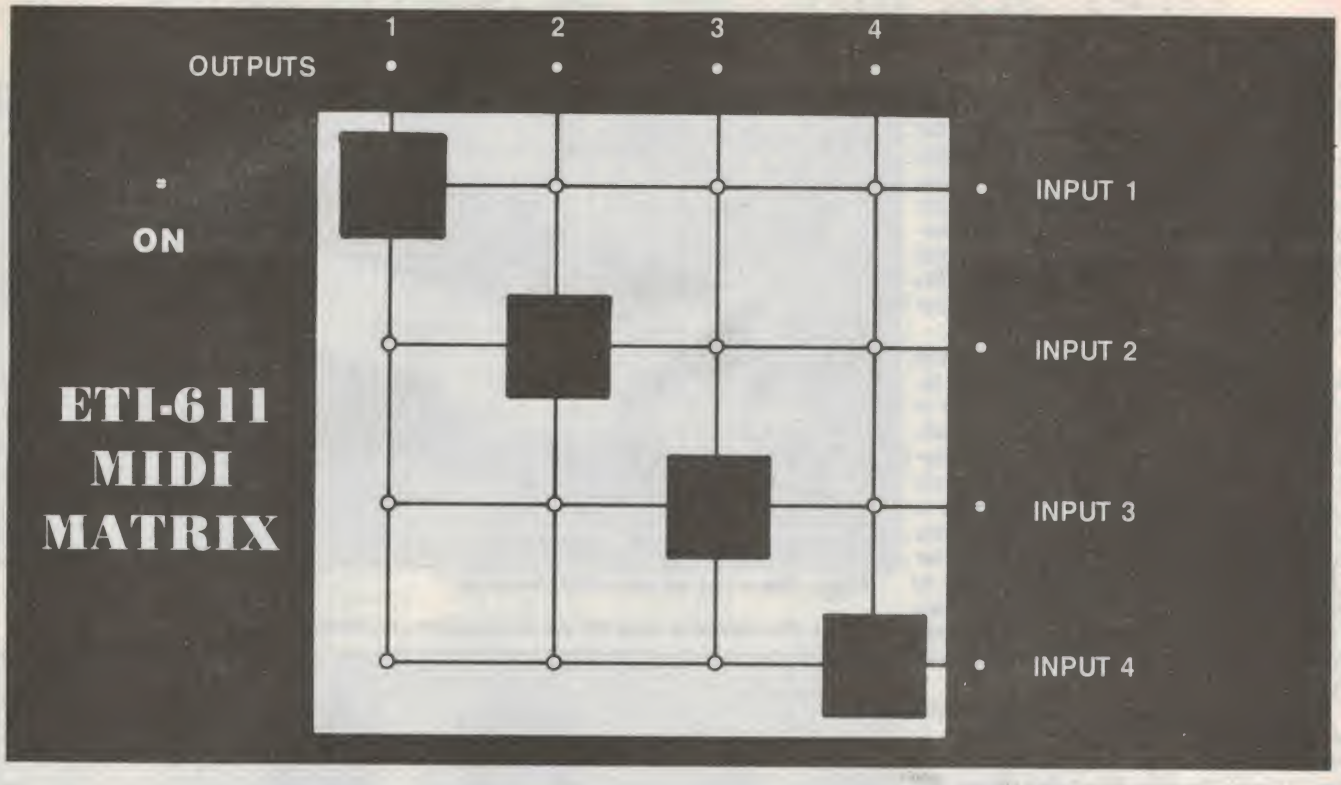
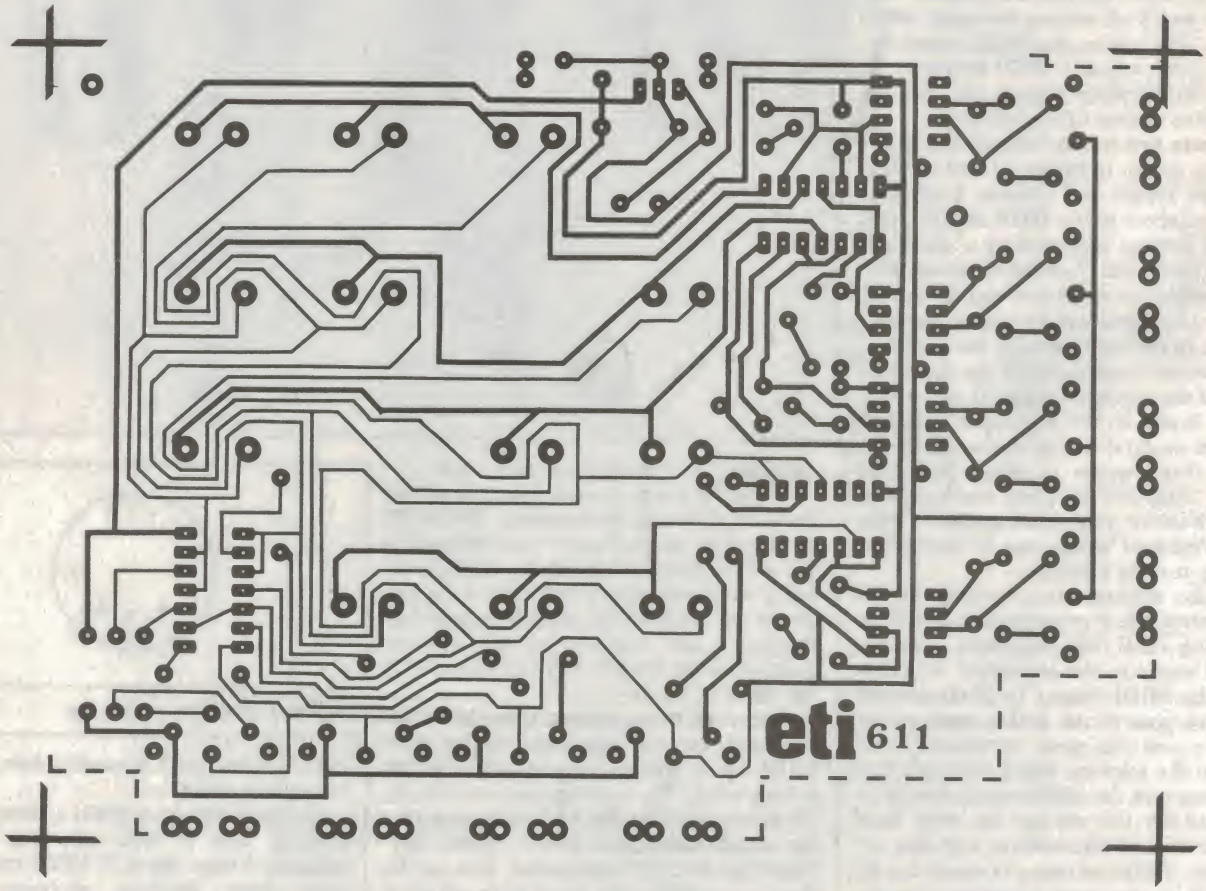


Figure 5. Rear view of DIN plug.

To those who have MIDI systems up and running, best of luck with your musical exploits; I hope the ETI MIDI matrix will bring your patching problems under control. ▶



ETI-611 MIDI MATRIX



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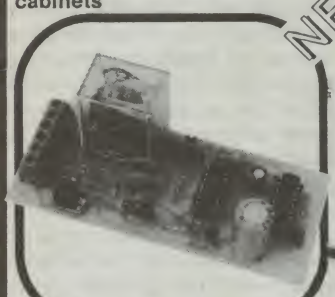

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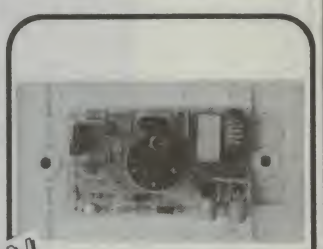

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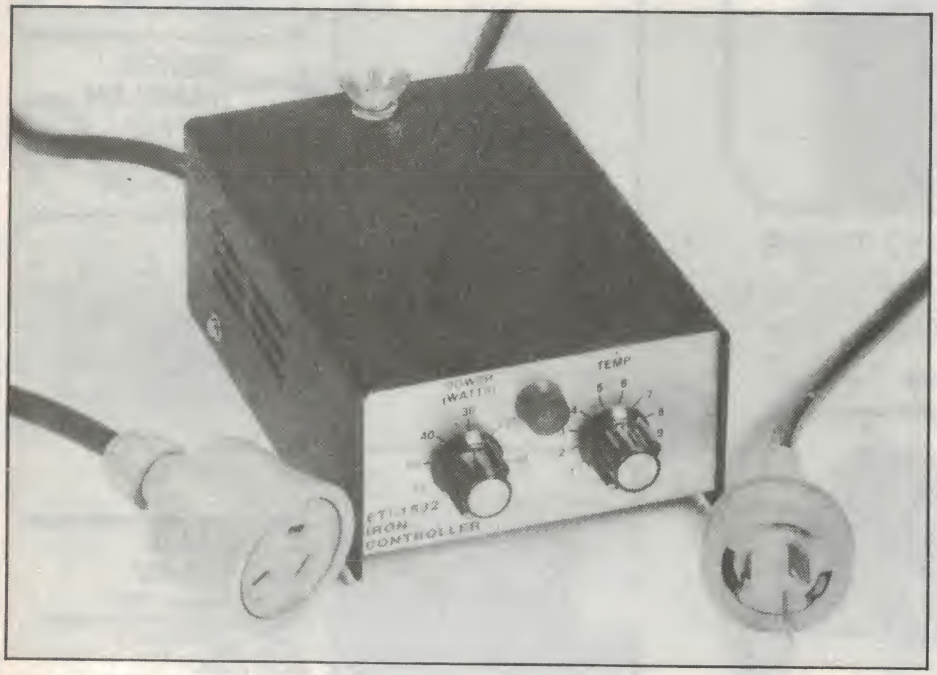
Project 1532

TEMPERATURE CONTROLLED SOLDERING IRON

If you have put off buying a temperature controlled soldering iron because they are so expensive, your problems are solved with this low cost soldering iron temperature controller. However, a substitute problem: how to solder the solderer?

Herman Nacinovich



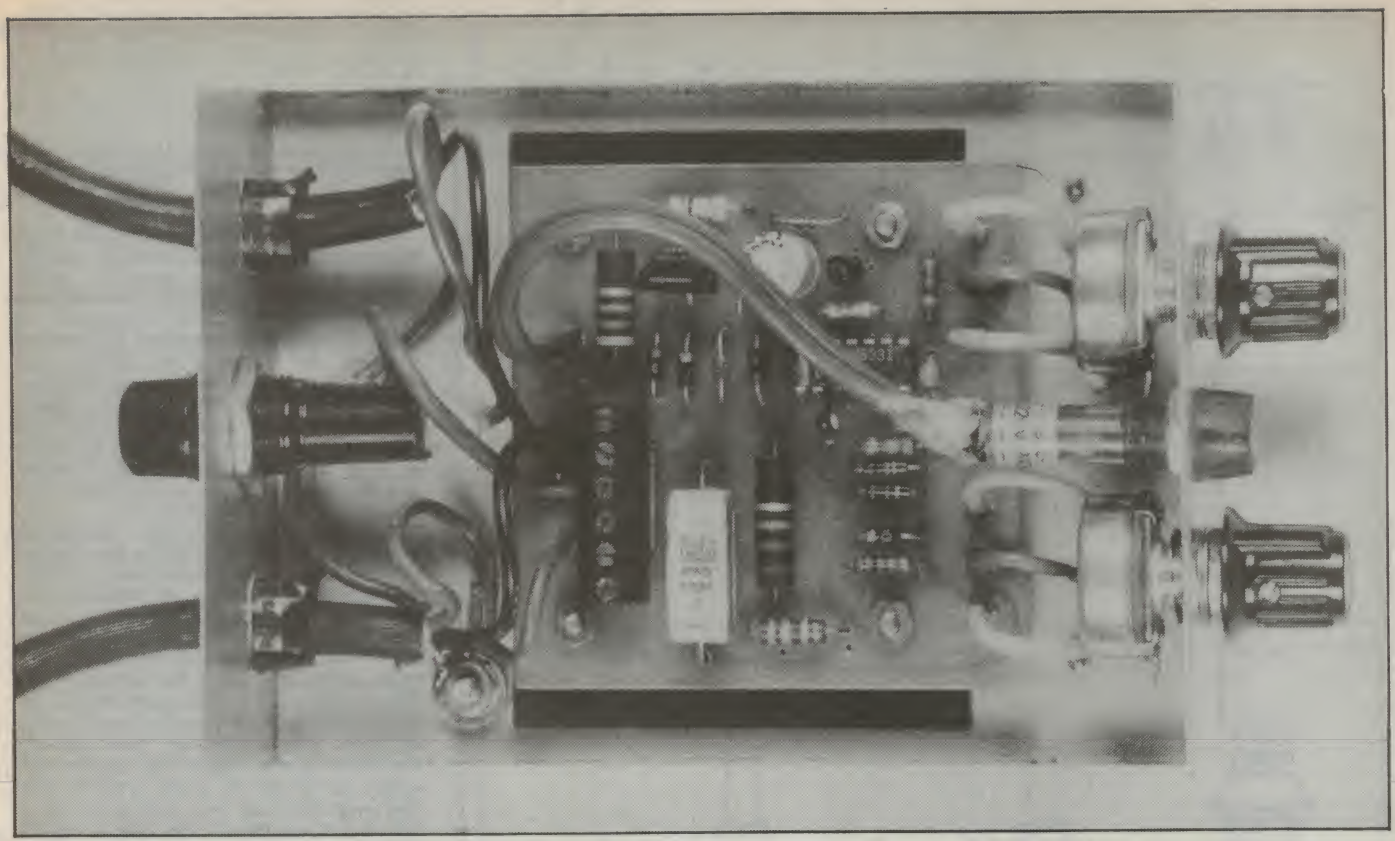
WHILE THIS TEMPERATURE controller may not have all the features of a soldering station, it provides fully regulated, adjustable temperature control over a reasonably wide temperature range. And there is no need to discard the soldering iron that you have now. This temperature controller will work with just about any conventional 240 V soldering iron rated from 20 W to 75 W, and can easily be adapted for use with higher powered soldering irons.

Why temperature control?

An important factor in good soldering technique is the correct choice of soldering iron temperature. Experience suggests that there is an optimum temperature for every soldering job and that this should be adhered to as closely as possible. Excessively high or low temperatures should definitely be avoided. Too high a temperature during soldering may obviously result in such nasties like damage to sensitive electronic components, tracks lifting off pc boards and the like. Too low a temperature, on the other hand, makes soldering difficult and increases the time required — which might also result in damaged components. Not only that, use of too low a temperature may lead to dry joints, an almost certain recipe for future circuit problems.

Where operating temperature is concerned, conventional (non-temperature controlled) soldering irons are anything but ideal. The two major problems with a conventional iron are that its temperature is not adjustable, and that its operating temperature is dependent on external factors such as the heat absorbing capacity of the components being soldered, and on variations in the supply voltage. A variation of ±10% in the supply voltage, for example, will result in approximately 20% variation in the heating power of the iron, all things being equal.

The power rating of an iron directly relates its suitability to any particular application. A typical iron intended for electronics work would be rated at around 20 W, which would be just adequate for average pc board work. But try to solder a large component, such as an electrolytic capacitor in a power supply with a 20 W iron and you might find yourself getting stuck (literally) because a lot of heat is being absorbed by the component, and the iron doesn't have enough reserve power to keep the solder above melting point. In such cases a higher power rated iron (eg, a 25 W or 30 W iron) is necessary. However, higher power means a higher temperature, especially when the iron sits idle in its stand or if it is only used for light work. There is then a greater risk of damaging components and the iron may



be uncomfortable to work with.

Before temperature controlled irons became generally available, it was sometimes necessary to have several different irons on hand so that the most suitable one for the job could be used. However, apart from the cost of having several irons, this approach is not very convenient. A temperature controlled iron does away with this inconvenience. In essence, a temperature controlled iron is one which is automatically switched off when it reaches operating temperature and switches on again (automatically) when it drops below operating temperature. This switching action provides for an iron with plenty of reserve power for those 'difficult' jobs without the danger of overheating. The benefits include constant temperature and adjustable temperature, consistent soldering quality, and use of a single iron for light and heavy work. Another advantage is that temperature controlled irons generally reach operating temperature much more quickly than conventional irons.

Typically, if you wanted the advantages of a temperature controlled soldering iron, you had to buy a soldering station which comes with a special, low voltage iron and inbuilt temperature sensor, or an iron with inbuilt temperature controlled switching. Now you can build one yourself.

Design considerations

Let's look at some of the ways in which the temperature of a soldering iron might be controlled. One method might be to use a rheostat in series with the soldering iron heating element. But this method is very inefficient because a lot of power would be dissipated in the rheostat, and besides, a rheostat capable of dissipating such power would be expensive and probably difficult to obtain.

Alternatively, the rheostat may be replaced by a diode. With ac power applied, the diode conducts during alternate half cycles, so that the soldering iron operates at half power. Short out the diode with a switch and the soldering iron operates at full power. This method is highly efficient because very little power is dissipated in the diode. But although simple and cheap to build, a diode controller is of very limited usefulness because only two control settings are possible. A better method would be to control the average power going to the soldering iron using an SCR or triac controller, such as in an ordinary light dimmer. However, SCR and triac switching circuits tend to generate considerable amounts of rfi (radio frequency interference) unless zero crossing switch techniques are used.

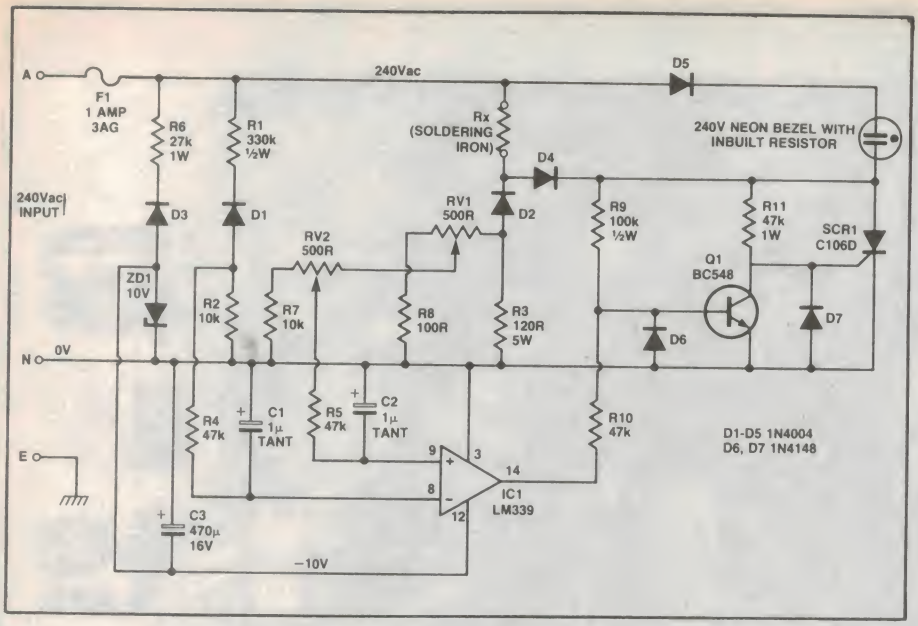
Each of the methods mentioned suffers from the serious drawback of poor temperature regulation. This means that the temperature of the soldering iron is influenced by external factors, such as variations in power supply voltage and the nature of the soldering work. This characteristic is undesirable and rules out these methods as such for a fully regulated temperature control system. To overcome this drawback negative feedback must be used. This requires the use of a temperature transducer of some kind to monitor the temperature of the soldering iron, and a switch responsive to the output of the temperature transducer to maintain the power to the soldering iron for the required constant temperature.

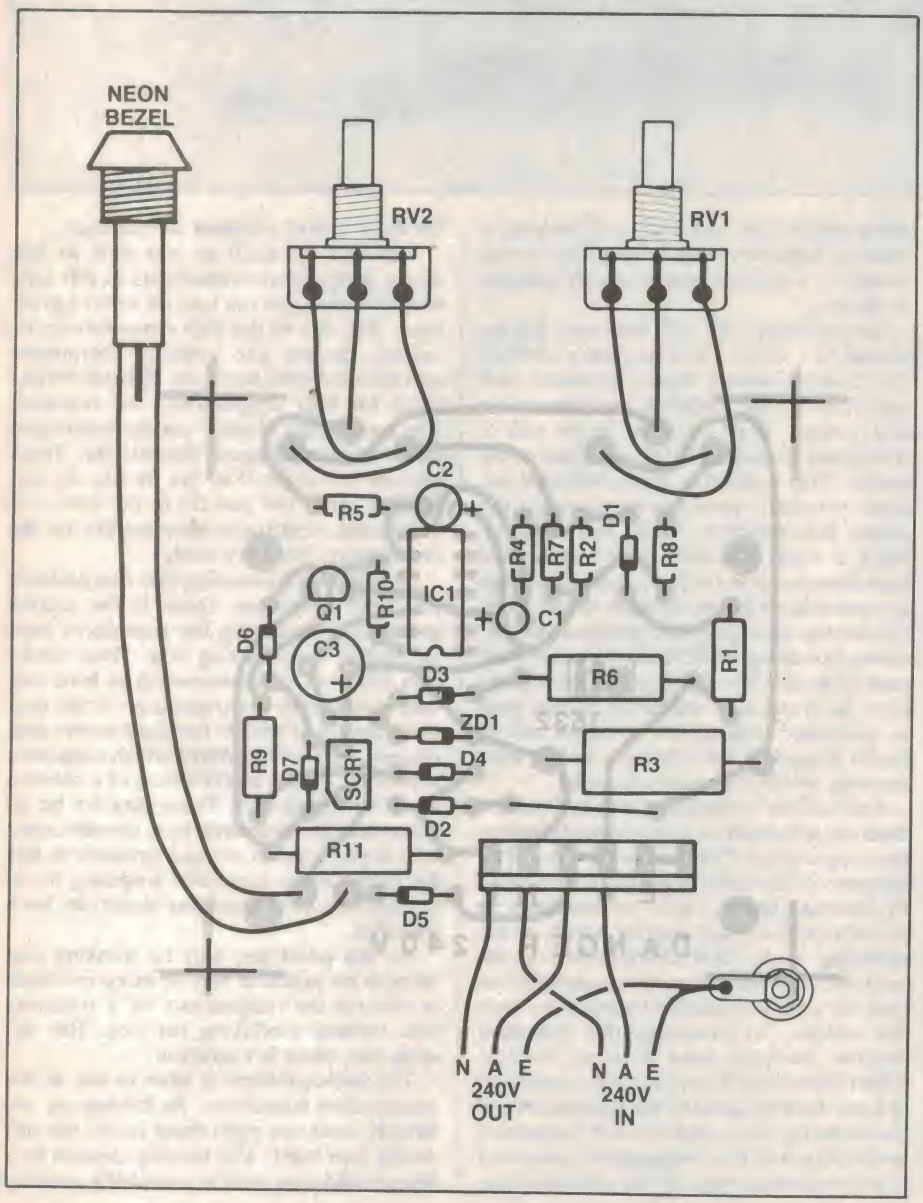
However, as soon as you start to talk about temperature transducers in this kind of application you run into all sorts of problems. Because of the high temperatures involved, devices like ordinary thermistors and silicon diodes won't do. Special devices rated for high temperatures are required. The most likely choices are thermocouples and 'high temperature' thermistors. These are not too difficult to get in lots of, say, 1000 or more but just try to get one from your local electronics supermarket or the distributors. Not very likely!

Nevertheless, assuming that this problem has been overcome, there is the second problem of mounting the transducer onto (or inside) the soldering iron. There would also have to be (presumably) at least one wire going from the transducer to the control circuitry as well as the usual power supply and earth wires. All of which suggests a somewhat drastic modification of a conventional soldering iron. These may not be insurmountable problems to a manufacturer who is prepared to set up a production line for temperature controlled soldering irons, but they are clearly serious objections for a hobbyist.

At this point you may be thinking that there is no practical way of using feedback to control the temperature of a soldering iron without modifying the iron. But despair not, there is a solution.

The basic problem is what to use as the temperature transducer. As it happens, we already have one right there inside the soldering iron itself. The heating element in a typical soldering iron is essentially nothing ▶





ETI-1532 — HOW IT WORKS

The soldering iron Rx, together with resistors R1, R2 and R3 and diodes D1 and D2, form a bridge which is connected across the ac mains power supply. The voltage at the junction of D1 and R2 is taken to the negative input of comparator IC1 via R4. Similarly, the voltage at the junction of D2 and R3 is divided down by potentiometers RV1 and RV2 and taken to the negative input of IC1 via R5. Components R4, C1 and R5, and C2 form low pass filters to reduce ac ripple at the comparator inputs. The output of comparator IC1 controls transistor Q1 which, in turn, controls SCR1.

Assume that RV1 (coarse adjustment) and RV2 (fine adjustment) have been set for a desired operating temperature. Initially, the soldering iron has a relatively low resistance. The output of IC1 is low, causing Q1 to turn off and SCR1 to turn on. Full power flows into the soldering iron and it heats up quickly. When the soldering iron has reached the set temperature, the output of IC1 goes high, turning on Q1 and turning off SCR1. The current then flows through the soldering iron only during negative half cycles via D2 and the power drops to half. The temperature will then start to fall below the set temperature and the cycle is repeated. Thus, the soldering iron is maintained at a relatively constant average temperature.

Diode D4 isolates the bridge from the SCR and associated drive circuitry which might otherwise load the bridge during

ETI-1532 — PARTS LIST

Resistors.....all 5% or better
R1.....330k, ½ W
R2, 7.....10k, ¼ W
R3.....120R, 5 W
R4, 5, 10.....47k, ¼ W
R6.....27k, 1 W
R8.....100R, ¼ W
R9.....100k, ½ W
R11.....47k, 1 W
RV1, 2.....500R

Capacitors
C1, 2.....1µ tant
C3.....470µ, 16 V electro

Semiconductors
D1-D5.....1N4004
D6, 7.....1N4148
Q1.....BC548
IC1.....LM339
SCR1.....C106D

Miscellaneous
1 A 3AG fuse; fuse holder; 6-way terminal block; 240 V neon bezel; 2 x cable clamp grommets; 2 x lengths 3-core flex; 240 V plug; 240 V line socket; 150 x 61 x 103 mm metal cabinet (Dick Smith (at H-2742); ETI-1532 pc board; Scotchcal label; 4 x plastic spacers; bolts; nuts; spring holder; 2 x crimp lugs; 2 x knobs.

Price estimate: $26

For a guide to components and kits for projects, see SHOPAROUND this issue.

negative half cycles and upset operation. A negative dc supply for the comparator is derived directly from the ac mains via a voltage dropping resistor, R6, and limited by zener diode, ZD1.

During operation, a neon indicator lights up when SCR1 conducts. When the soldering iron is either above or below the set operating temperature, the neon indicator is either fully off or fully on, as the case may be. The neon indicator flashes when the soldering iron is at operating temperature.

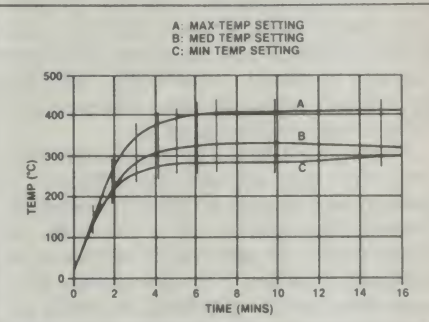
A feature of this circuit is that SCR1 is turned on only near zero crossings of the ac voltage waveform, thereby minimising rfi (radio frequency interference).

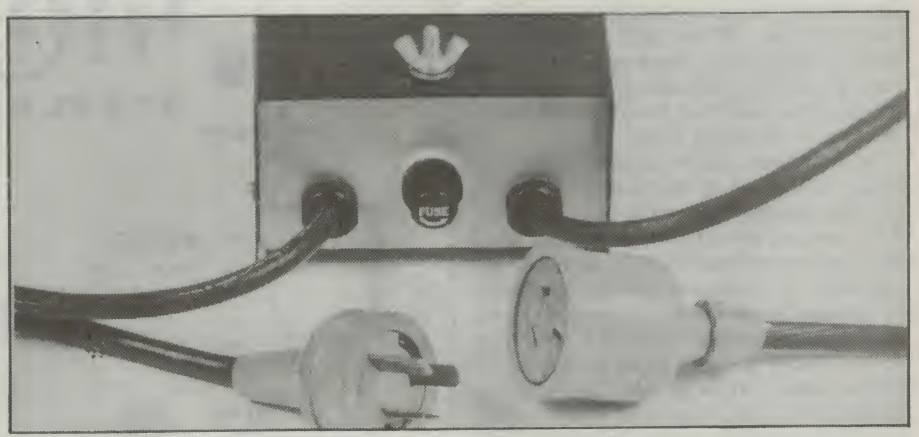
Here's how it works. Assume that the output of IC1 is low. At the beginning of a positive half cycle, the voltage across resistors R9 and R10 is relatively low and transistor Q1 is prevented from turning on by the low output of IC1. Current therefore flows into the gate of SCR1 via resistor R11 and, being a sensitive gate device, the SCR turns on early in the half cycle. Suppose, however, that the output of IC1 happens to go low in the middle of a positive half cycle, when the voltage across resistors R9 and R10 is fairly high. These resistors form a potential divider with the base of transistor Q1 connected to the junction. In this case, Q1 is turned on despite the low output of IC1, thereby shorting out the gate current of SCR1 and preventing it from turning on.

TABLE 1. SUGGESTED COMPONENT VALUES FOR DIFFERENT RANGES (see text).

Range	R3	R8
20 ~ 30 W	100R	680R
30 ~ 40 W	68R	820R
40 ~ 60 W	47R	680R
60 ~ 75 W	33R	1k
75 ~ 100 W	27R	820R
100 ~ 120 W	18R	1k8
120 ~ 150 W	15R	1k5

Results with 'Lotring' iron





more than a wirewound power resistor. Now, it is the usual characteristic of a resistor that its resistance changes with temperature. The temperature coefficient (proportional change in resistance per degree change in temperature) may vary with the type of resistance wire used by the manufacturer, but all practical resistors exhibit some change in resistance with temperature. If then the resistance of a soldering iron heating element could be measured on a continual basis while the soldering iron is being used, it would be the ideal transducer for temperature control.

Circuit details

The soldering iron temperature controller is designed to be connected between a 240 Vac mains outlet and a soldering iron. The circuit works directly off the mains and derives a low voltage dc supply for the electronics via a straightforward resistor zener diode network (R6, ZD1). Two front panel controls are provided. A coarse adjustment pot RV1, labelled POWER, is calibrated approximately in terms of the nominal power rating of the soldering iron being used (from 20 W to 75 W). A fine adjustment pot RV2, labelled TEMP, is used to set the operating temperature of the soldering iron. Ideally RV2 could be calibrated in degrees centigrade. However, this project was designed as a general purpose device and, since different soldering irons are likely to differ in their temperature/resistance characteristics, a single calibration would not necessarily be valid for different irons. For that reason, in the case of the prototype, RV2 was simply given an arbitrary calibration from 1 to 10. A neon lamp which lights up when SCR1 conducts provides a useful indicator for setting up and adjustment of the front panel controls.

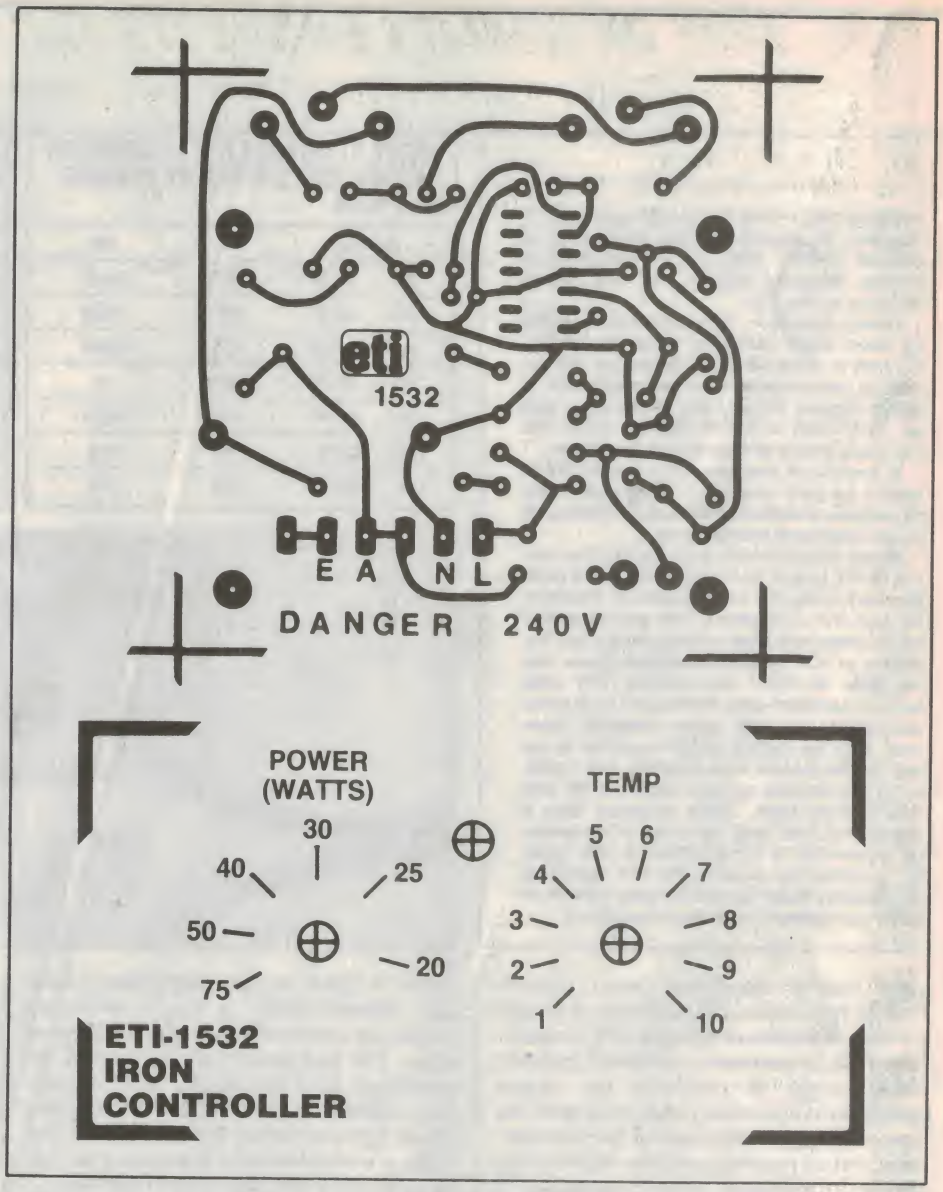
With the component values shown in the schematic, the range of adjustment available is limited for use with soldering irons rated from 20 W to 75 W (approximately). For irons rated less than 20 W, the benefits of temperature control are marginal at best, since these irons have barely enough power for most jobs anyway. If you want to use the soldering iron temperature controller for irons rated above 75 W, replace R3 with a lower valued resistor. In fact, by suitable choice of R3 and R8 the range of adjustment can be optimised for a particular iron. Table 1 gives some suggested resistor values for different irons. These figures have not been verified by experiment so you may have to alter the values slightly if you do not get the range of adjustment that you need.

Construction

For this project, I chose a metal cabinet to house the 'works' rather than a plastic one because a plastic one would be all too easily damaged by accidental contact with a hot soldering iron. Because of the metal construction and because of the presence of dangerous voltages on the board, there are several precautions which the constructor MUST be aware of. First of all, the metal cabinet and all exposed metal parts, such as knobs, pot shafts, etc, MUST be securely earthed. When making earth connections, for example, do not merely solder an earth wire to a lug but use a crimp or other mechanical connection to ensure secure contact. Although human contact with mains neutral or a short circuit between neutral and earth will not have serious consequences, *assume that all components on the pc board are or could be at a potentially dangerous live voltage.* Therefore at every stage of construction check that there is no weak point at which any of the components could make contact with each other or the metal cabinet.

Construction may begin with the pc board on which most of the components apart from RV1, RV2, fuse holder and neon bezel are mounted. Before soldering components, check the board carefully to make sure that there are no bridges between tracks or breaks in any of the tracks. The components may now be soldered to the board in any convenient order, but I would suggest that you start with the smaller components and leave the larger components, such as the electrolytic capacitor and terminal block till last.

If you wish, you can use an IC socket for ▶



IC1. After all of the on-board components have been soldered in check that all polarised components, which include IC1, Q1, SCR1, the diodes and capacitors, have been correctly mounted. Incidentally, reversing the polarity of any of these will most certainly cause problems later on.

Now connect up the potentiometers RV1 and RV2 with approximately 50 mm of hookup wire to each terminal (use only insulated wire rated at 240 V/250 V for all connections). Be particularly careful when soldering the wires to the pot terminals because these could easily bend and make accidental contact with the metal case if the connections are not carefully made. Also, break the lug off the SCR as this is not needed. Now, solder two lengths of hookup wire, about 75 to 100 mm each on the board for the neon bezel but do not as yet solder the ends to the neon bezel.

Leaving aside the pc board for the time being, drill holes in the front panel if this has not already been done for pots RV1, RV2 and the neon bezel. A photocopy of the front panel artwork could be used conveniently, as a template for this operation. In addition, holes will also have to be drilled in the base for the pc board mounting screws and in the rear panel for input and output cables and for the fuse holder. Ream or file away any burrs and rough edges. Carefully apply the Scotchcal label to the front panel, making sure that the hole positions on the label are exactly aligned with the holes in the front panel, then cut out the holes from the label. Drill a hole in the cover to receive a bolt for fixing a spring-type soldering iron holder, if desired.

Now you can mount the pc board in the cabinet using machine screws and plastic spacers. If you elect to use metal spacers, use plastic insulating washers between the spacers and the pc board so as to make absolutely sure that there is no possibility of electrical contact between the metal spacers and any of the tracks on the board. It is also recommended that, when mounting RV1 and RV2 to the front panel, spacers such as washers or nuts be used between the pots and the front panel so that the metal cases of these pots are not mounted too closely to the panel. The reason for this is to leave a wide gap between the soldered pot terminals and the metal panel so as to lessen the risk of accidental contact between them. If you wish, you could lay a piece of plastic (say, about 0.5 mm or 1 mm thick) over the inside face of the front panel so as to prevent any chance of such contact.

Testing and calibration

When construction is completed and everything checked, plug in a soldering iron and switch on. Turn the POWER knob from the fully anticlockwise to the fully clockwise position. If all is well, the neon indicator will light up when the setting corresponding approximately to the rated power of the soldering iron is reached. If the neon lamp doesn't light up or is constantly on regardless of the knob position, switch off power and check for faults.

Assuming everything is OK, adjust the TEMP pot to about mid-position and allow the iron to heat up to full operating temperature. Now, turn the POWER knob (RV1) till the neon lamp is just on the point of going out. The neon lamp will begin to flicker, a sign that the circuit is working, and the soldering iron is ready for use. If desired, you can then make fine adjustments to the soldering iron temperature using the TEMP control. If you want to calibrate the unit in terms of actual temperature, this can be easily done using a soldering iron temperature meter. (I purchased a low cost meter from Jaycar not very long ago for this purpose; such meters may still be available from there and possibly some of the other retailers.) Note, that the calibration will change if the POWER select knob is moved and that the calibration may not be the same for a different iron, even if of the same power rating due to slight variations between irons.

If the temperature controller doesn't work, the first things to check are the power supply connections and that all of the components have been soldered in the right way around. *Under no circumstances start prodding around the circuitry with the power switched on.* If the fault still can't be found you might try checking all the resistors, since the circuit may not work if resistors of incorrect value have been used or if the tolerances of critical resistors are way out. The critical resistors are R1, R2 and R3. Also, don't discount the possibility of a short circuit between tracks, for example due to solder bridges or a break in one or more tracks. Generally, these are readily checked using a high power magnifying glass. As a last resort, you may have to check if individual components have failed, although this is not very likely if care has been taken during soldering. ●

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Project 1605

FORTH ANALOGUE CARD

Talk to the real world. This add-on to the ETI-694 Forth board will allow the RSC-Forth development system to interface to analogue inputs or outputs. It has a programmable amplifier, a watchdog timer, in fact all the goodies you need. Go Forth, and you will multiply and add and divide and . . .

OH NO, I hear you say, not another computer language. However, if you're into controlling robots, mechanical arms, washing machines, train sets, etc, then it's about time you looked more seriously at Forth. It is a language which was developed with control in mind and is more flexible than either Fortran and BASIC when it comes to whizzing stepping motors around or checking the status of sensors.

In fact, it was designed at Kitt Peak solar observatory by astronomers who needed to make rapid calculations and then use the results to drive telescope control motors.

To briefly summarize its features, Forth is a language in which you add your own operations by defining them in terms of previously defined operations until a single word (or operation) represents your whole program. It is a structured language. It uses the concept of Reverse Polish Notation (RPN) and is quite easy to learn. Most people agree that it is simpler to use than Assembler yet has many of its advantages.

For those curious about the language there are two excellent books that I can recommend. The first is *Starting Forth* by Leo Brodie which takes you through programming, etc using drawings, cartoons and the like. Certainly a good beginner's book but not recommended for anyone who already knows about computers. The second book is the *RSC-Forth User's Manual* which comes with the kit from Energy Control. It describes the Forth development system and language extremely well and saves you from having to plough through loads of rubbish to find relevant information.

Up until now, the way of getting hands-on experience with Forth was to purchase a disk or tape and load it into your home computer. Rockwell, however, recently developed a complete ROM based Forth system consisting of the CPU, memory, I/O facilities and the RSC-Forth software integrated into a single chip. Thanks to Australian Rockwell agents, Energy Control, a low cost single board microcomputer which runs Forth is now available.

It was described in ETI May 1985 as the ETI-694. A development of this basic project was described as ETI-696 (Dec 85) and shows how to interface the system to disk drives and printers. It also implemented some input/output ports to allow you to control the outside world.

A major limitation is that the I/O is digital, a problem in an analogue world. This project describes an interface for the development system that implements eight input analogue channels and two analogue outputs.

Description

The board mounts piggy-back fashion on the development system. It is designed to slot directly into the 65F11 socket, using a 40-pin DIL connector. The analogue board carries a 65F12 which replaces the 65F11 as the controller for the whole system.

Input is achieved via any one of eight input channels. They are time multiplexed together and then presented to the analogue-to-digital converter (ADC). The parallel output from the ADC is read directly into the data bus of the 65F12.

The resolution is eight bits wide. However, between the multiplexer and the ADC a programmable amplifier has been installed, with gain that can be switched between 1, 2, 4, and 8.

This function can be used in a number of different ways. It can improve the dynamic range of the system, improve the resolution, or even be used to implement autoranging functions if required.

Both the multiplexer and the amplifer are controlled by a bus extending from port E. Table 1 gives a combination of outputs from this port.

The output chain is also multiplexed. The data bus is fed to two digital-to-analogue converters (DACs), either of which can be selected by software.

Finally, two of the digitial ports on the 65F12 are available to the outside world through one of the connectors.

Construction

Building the Forth analogue card ought to present few problems. Start by examining the board in the usual fashion for defects to tracks or bridging. In view of the professional nature of the boards you should find very few.

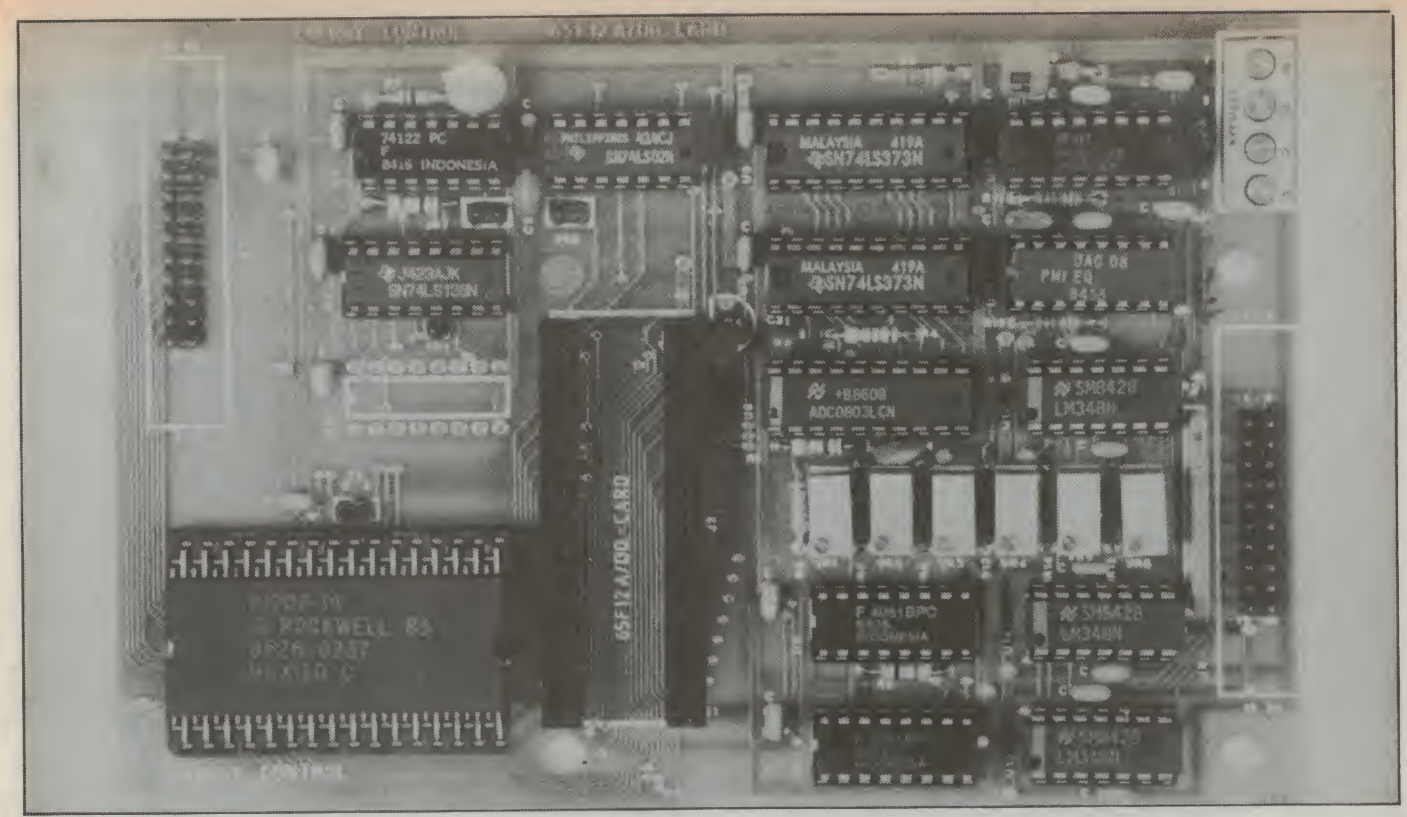
The first thing to do is to put in a jumper from pin 13 of U11 to the 12 volt positive rail. This is missing from the artwork. Then mount all the small components, resistors and capacitors, as well as the jumper blocks JB1, JB2 and JB3. Pay particular attention to the zener diode. This comes in a transistor-like package, and should be inserted with an orientation opposite to that shown on the board.

Solder in the IC sockets, carefully checking for solder bridges as you go. Some people may prefer to ignore the sockets, and solder the ICs directly into the board. This is probably a more reliable way of connecting the IC to the board, but bear in mind that if you make a mistake you will probably not be able to remove the chip without a great deal of pain.

Finally, make up the connection to the development system by pushing the 20-pin wirewrap strip through the board as shown in the photograph. When you have soldered it into place, secure a 40-pin DIL socket onto the ends of the wirewrap terminals to give the whole unit some stability.

Now plug it into the 65F11 socket on the mother board and connect up power to the socket in the corner of the board. Notice that the numbers on the plug might not be the same as the numbers on the board.

Stand back while you switch on. If you see the RSC-FORTH V1.7 message on the screen then you did all right — if it blows up in your face you probably made a boo-boo.



Calibration

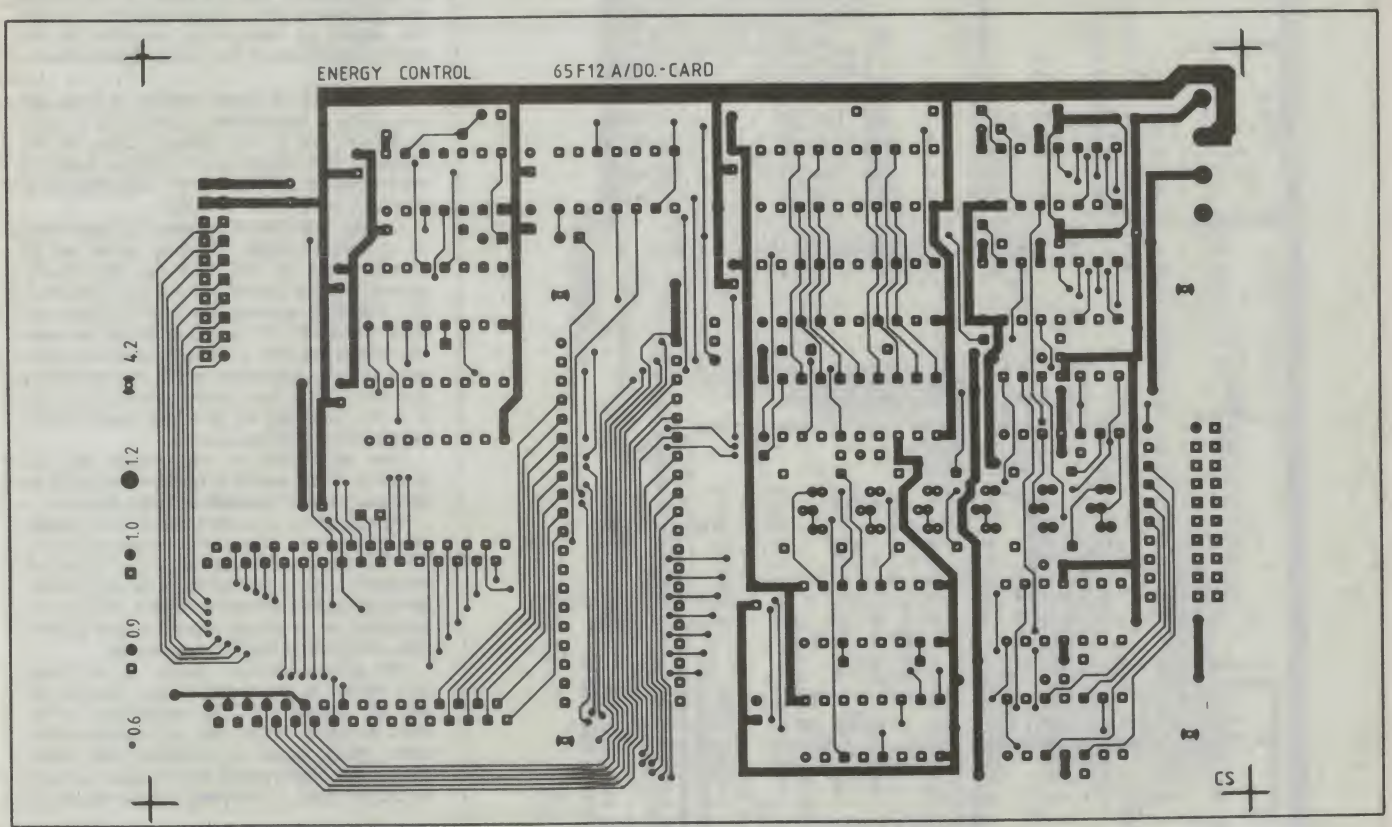
If all is well, the next stage is calibration. This involves setting up both input and output ports so that the 65F12 is given true information about the value of the voltage on the output.

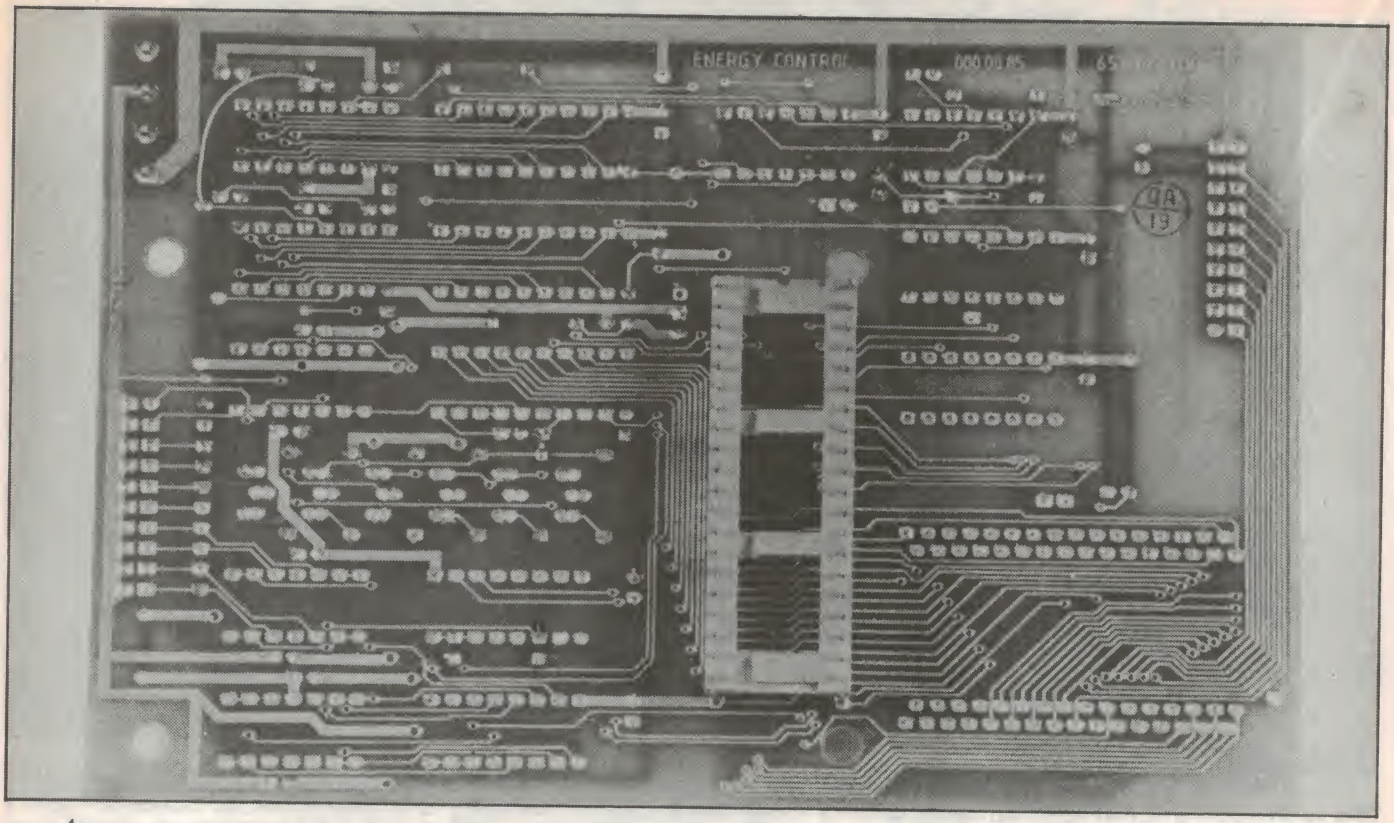
Essentially, the procedure is to drive the output ports high, then adjust the appropriate variable resistors until precisely 5V is output. The inherent linearity of the device will take care of all the other states. It's probably a good idea to check at least that the zero state 00 in fact outputs zero.

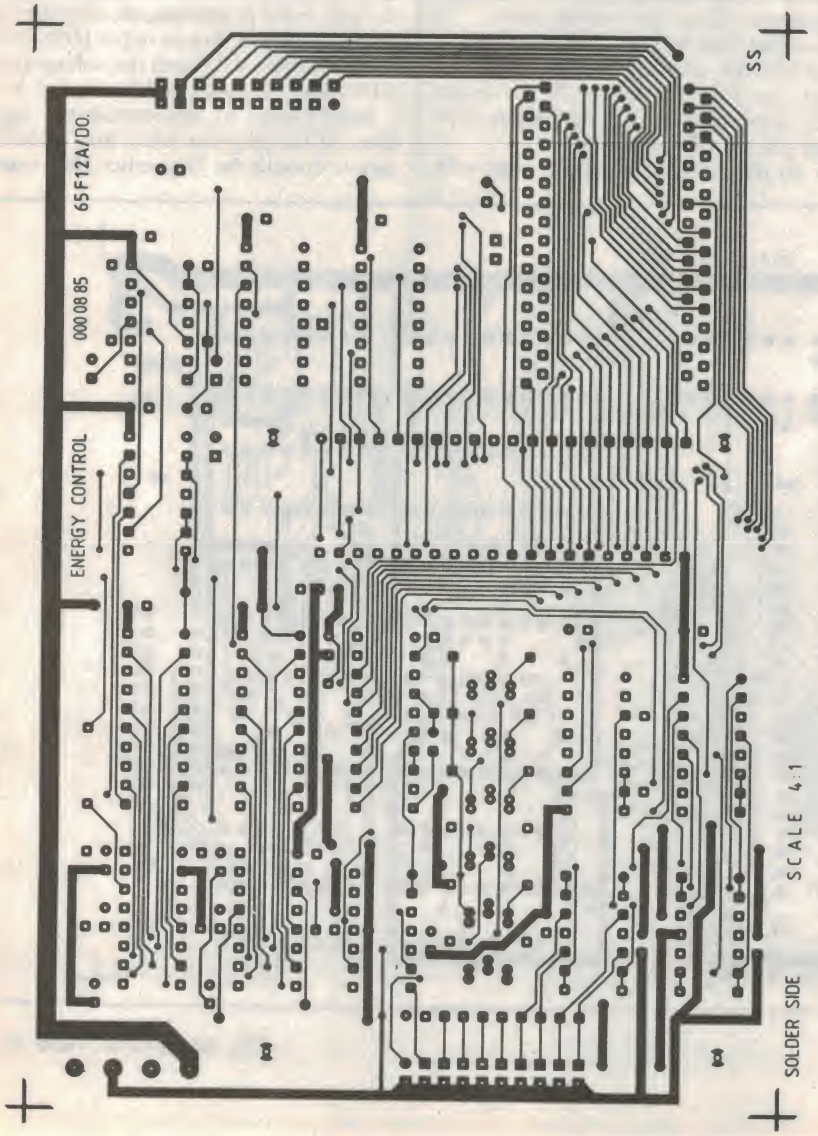
To adjust DAC0, write FF to the appropriate address, and adjust VR6 until the output, pin 3 on J4, reads 5 V. To adjust DAC1, similarly write FF, and adjust RV4 so that pin 1 on J4 reads 5 V.

To do the ADC calibrations, start with channel zero, pin 19 on J4, and connect 5 V to it. Now, select the channel and specify the gain in the programmable amplifier, and send it to port E. For example HEX 00, PE C!. Now adjust VR5 until the voltage on the ADC input, ie, pin 6 of U8, reads 5 V.

Incidentally, to understand the significance of the program line it may be neccessary to consult the December 1985 issue of ▶







ETI-1605 — HOW IT WORKS

One can divide the ETI-1605 into two functional groups: input channels and output channels. The inputs are available on the J4 connector, from where they go to an op-amp connected like a buffer, ie, its gain is one (U14 and U15). Its function is to make the board as immune as possible to the input resistance of the device connected to it.

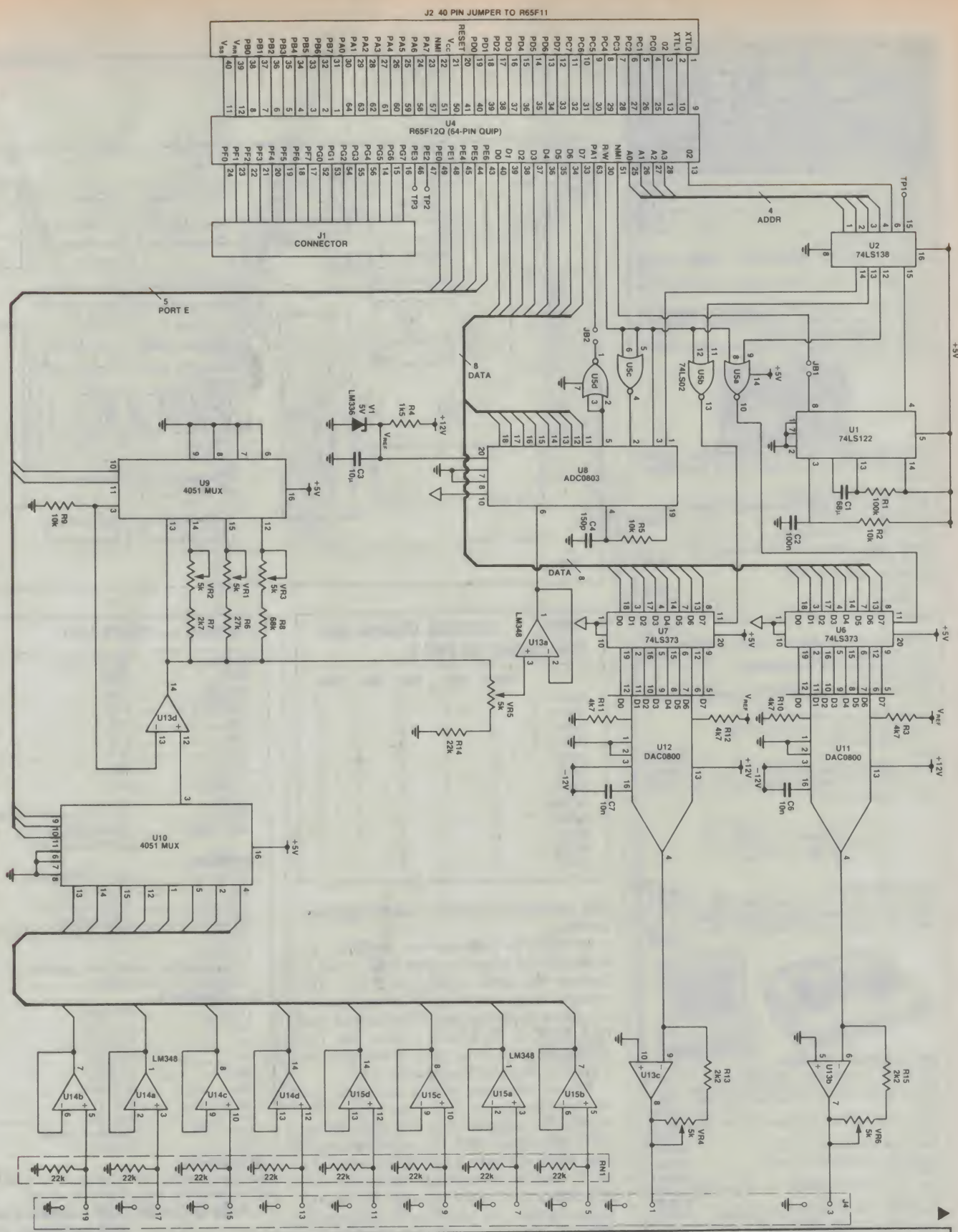
The output of these buffers is then fed into U10, a multiplexer, whose job it is to pass just one of the voltage values on the input to the output pin 3. Which input is connected is defined by the selecting pins 9, 10, 11, connected to port E.

Output from the multiplexer is then sent to a programmable amplifier made up of two sections of U15, VR5 the 4051 multiplexer and the associated resistor networks. By selecting appropriate combinations on pins 10 and 11 of the 4051, which are also controlled on port E, it is possible to connect some combination of R7, R8 and R9 to ground. This in turn, gives gain of 1, 2, 4 or 8 to the amplifier by shunting some of the output from U13d to ground.

Fine adjustment of the voltage can be made by VR15, which is buffered by U13a to give low output impedance to the network.

On reception of a start conversion signal on pin 3, and a chip select signal on pin 1, the ADC formed by U8 takes the analogue voltage on pin 6 and spits it out as a parallel combination on the data bus. This is interpreted as a digital word by the 65F12, thus completing the A-D conversion.

The output channel begins at the data bus, which is presented to two latches U6 and U7. These form the beginning of the DAC process. When the appropriate chip select (CS) signal is received, the latch places the digital word on the data bus on its output pins. It will keep this word there,



irrespective of other activity on the bus, until the next CS signal comes along.

The digital word out of the latch is presented to the DAC, which converts it to an analogue voltage between 0 and 5 V in 128 steps, depending on the value of the word.

This output is buffered by an op-amp to provide a low output resistance. The gain of the op-amp is set by the resistor network around it. One of these resistors is made adjustable so that precise output voltages can be achieved.

Both the ADC and the DAC require a very good reference voltage to provide accurate conversion. This is provided by V1, a 5 volt zener. R4 provides 4.6 mA to drive Vref, which is presented directly to pin 20 of the ADC, and to the DACs via a 4.7k resistor.

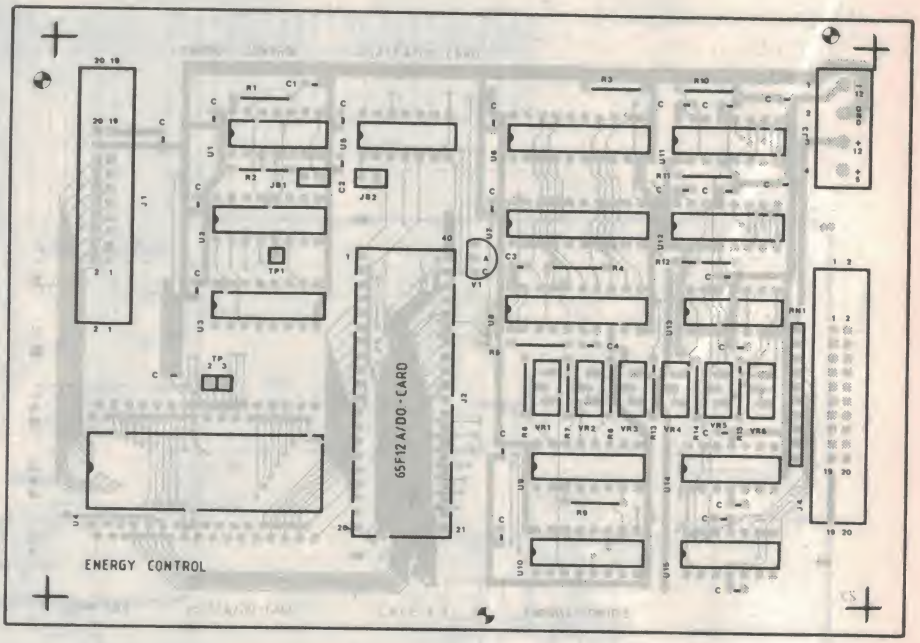


TABLE 1. Decoding Channel and Gain selects on Port E

	PE0	PE1	PE4	PE5	PE6
Gain = 1	0	0	X	X	X
Gain = 2	1	0	X	X	X
Gain = 3	0	1	X	X	X
Gain = 4	1	1	X	X	X
ADC0	X	X	0	0	0
ADC1	X	X	1	0	0
ADC2	X	X	0	1	0
ADC3	X	X	1	1	0
ADC4	X	X	0	0	1
ADC5	X	X	1	0	1
ADC6	X	X	0	1	1
ADC7	X	X	1	1	1

ETI and the description of the development system.

In order to calibrate the amplifier, it's neccessary to adjust the pots VR2, 3 and 4. Reduce the input voltage to 2.5 V. The voltage on pin 6 of the ADC should follow, suit. Now re-address port E, selecting a gain of 2. HEX 01 PE C! will achieve this. The voltage on pin 6 of the ADC should jump to 5 volts. If it doesn't, adjust the VR2.

Repeat with gains of four and eight. Set the input voltage to 1.25 V and adjust VR1 so that 5 V appears on pin 6, then set up 0.625 and adjust VR3. It's probably a good idea while you have a voltmeter connected up, to confirm intermediate values and also all values on the other channels. Be careful not to saturate the amplifier by going much above 5 volts. It may not be possible to get it precisely correct across all channels, in which case you might have to make some intermediate settings that make everything nearly correct. An alternative of course, is to set it correctly on one channel, and note the errors on the other. ●

ETI-1605 — PARTS LIST

Resistors.....all ¼W, 5%
R1.....100k
R2,5,9.....10k
R3,10,11,12.....4k7
R4.....1k5
R6.....27k
R7.....2k7
R8.....68k
R13,15.....2k2
R14.....22k
RN1.....47k SIP resistor network
VR1-VR6.....10 turn 5k0 cermet (Spectrol 64Y502)

Capacitors
C1.....68µ 16 V tantalum
C2.....0.1µ ceramic
C3.....10µ 1 V tantalum
C4.....150µ ceramic
C5.....at pin 16 of U11,U12 0.01µ
C6,7.....10n
20 decoupling capacitors marked on the overlay as 'C' 0.1µ bypass.

Semiconductors
U1.....74LS122
U2.....74LS138
U4.....R65F12AQ
U5.....74LS02
U6,7.....74LS373
U8.....ADC0803
U9,10.....4051
U11,12.....DAC0800
U13,14,15.....LM324 or similar
V1.....LM336 5 V

Miscellaneous
pc board available from Energy Control ($8.00); 20-pin wirewrap strip: 40-pin DIL socket.

Price estimate: $89 excluding tax
$99 including tax

This project is available from Energy Control, PO Box 6502, Goodna, Qld 4300. (07) 288-2455. Included is an operations manual with some software examples to drive the ports of the ETI-1605.

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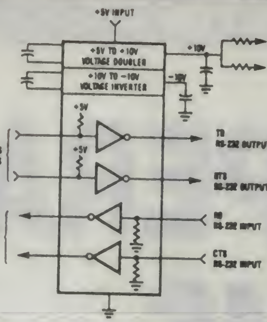
MC6845P CRT Controller



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Two projects use these chips – the AEM4505 Speech Synthesiser (Feb 86) which includes Microbee software plus an article on Speech Synthesis in general. The other project is in June's AEM and converts ASCII text files into speech – ideal for talking word processors. This one is for the IBM PC and works just like a printer.

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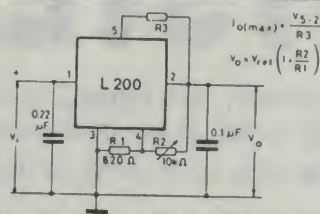

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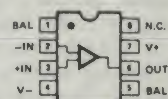

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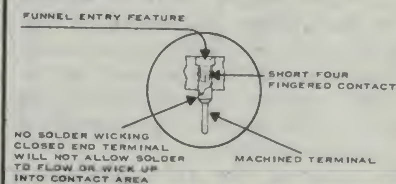

CONVERT YOUR MULTIMETER INTO A THERMOMETER

See ETI June 83 which features a project using the AD590JH (ETI-153). The AD590JH produces an output current proportional to absolute temperature. It's ideal for remote sensing as long cable runs have negligible effect on accuracy over a hundred metres or more! The simplest circuit requires one resistor and one pot and a battery, but better to build the proper circuit and get an accurate 10mV/degree centigrade output to put into your DMM. The AD590JH is only **$5.95.**

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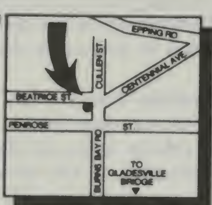

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DISK OPERATING SYSTEMS

Last month, we looked at the disk drive. This part of the series looks at the software that makes the disk drive usable — the disk operating system.

IT'S ALL VERY well having a disk drive that can hold 10,000,000 characters of information — how do you know where it all is on the disk? How do you know which part of that 10,000,000 bytes is your mailing list, and which is your word processor program?

Organizing the information on the disk is one of the jobs of the disk operating system (often shortened to 'DOS'). There are many varieties of DOS, but they all operate in much the same way.

Most DOSs need some sort of program built into the computer's ROM to tell them how to start reading information off disk. Typically, when the machine is first turned on it follows that ROM program to start the disk drive turning and to start reading the rest of the DOS program from a predetermined part of the disk.

This achieved, the DOS program is loaded into RAM, and is then run just like any other program. DOS stays in RAM while the computer is on and is wiped out when you turn the machine off. The next time you turn the machine on, it will load DOS from disk again.

The advantage of this arrangement (as opposed to having the whole of DOS in ROM) is that it's very easy to change to a different version of DOS — you just start using a disk with the new version of it. DOSs change fairly quickly these days: one very widely-used DOS, MS-DOS, is already available in version 3.1, and it's only been around a few years.

Once the memory-resident part of DOS has been loaded into RAM, it can start to ask the user for instructions. All DOSs organize the information on a disk into a number of files, each of which has a name given to it by the user. These filenames are how the user tells the computer what to do with the information on the disk.

For example, when you first create your mailing list (a list of names and addresses for producing envelope labels from), you might typically give the file the name MAILLIST (most DOSs can only handle capital letters, numbers and symbols in file names).

To create the file, the DOS first loads the directory from the disk into RAM. This directory is a list of all of the files already on the disk, plus the particular parts of the disk that they cover. For example, the first file may start at track 2 sector 3, and cover sectors 4 and 7 on track 2 and track 3 sector 8. (See last month for an explanation of 'track' and 'sector').

So, to create a file the DOS has to find a blank part on the disk — let's say that the next blank spot available is track 4 sector 5. It does that, and then makes another entry in the directory with the file name MAILLIST, and makes a note that it starts at track 4 sector 5.

Now you start entering information into the MAILLIST file. DOS will record the information on track 4 sector 5, until that sector is full, and will then look for the next blank sector on the disk, which may be track 6 sector 7. As you enter more information, it will start recording it at track 6 sector 7, having made a note in the directory of the disk that this is the next sector in the file.

Random

Since during creation of a file it is not possible for the DOS to know how much space the file is going to take up, the directory actually holds a list of each track and sector that the file is in. Files are spread across the disk in a random manner.

The great thing about disk operating systems is that all of this allocation of sectors goes on without your knowledge. All you see is the information going into a particular file, with a particular file name.

Later, when you want to get the information back off disk, you just tell the DOS the file name that you gave it, and it can look to the appropriate places on the disk and fetch the information in the same order as you typed it in.

Other functions that the DOS can provide directly for the user are:

listing the directory: listing on the screen all of the filenames in the directory of a disk;
renaming files: changing the filename recorded in the directory without altering the file;
erasing files: removing the directory entry;
copying files: copying the contents of one file into another file;
printing files: sending the contents of a file to the printer;
listing a file: putting the information from a file onto the screen.

So the DOS provides an easy way to control the allocation of space on a disk to particular files of information.

User interface

The user interface part of the DOS is the part that actually talks to the user. It's the part that interprets the commands you type in.

There are basically two styles of user interface on the market these days which I will call the MS-DOS standard and the Mackintosh standard.

The MS-DOS standard is based on a line-by-line entry of typed instructions into the computer. A typical sequence is shown in Figure 1.

The [D] is a prompt to tell the user that the DOS is ready for the next command. First, the user types in dir to get a directory listing. This shows each of the filenames on the disk in the form WS. COM, followed by the number of bytes in each file (1.622 in WS. COM), followed by the date and time of creation — the date is in American format MM-DD-YY. At the bottom of the directory listing the DOS tells you how much space is left on the disk (6528 bytes).

The other standard for user interface is radically different from this one. It was pioneered by Xerox in the US some years ago and first found its way into microcomputers in the Apple 'Lisa' computer, which formed the basis for the much smaller Apple 'Mackintosh' machine.

Its user interface is a pointer which the user moves around the screen, either by giving it instructions from the keyboard, or by using a device called a 'mouse', which you push around the top of your desk. As you move the mouse away from you, the pointer moves up the screen; when you move it to the right the pointer moves to the right on the screen, and so on. As you move the mouse away from you the pointer moves up

```
[D] dir

 Volume in drive D has no label
 Directory of  D:\eti

.            <DIR>       4-11-84  12:10a
..           <DIR>       4-11-84  12:10a
MIC      DOC     12918   7-16-86   9:18a
ETI      HED       100   5-22-86   6:16a
WS       COM      1622   7-16-86   1:15p
        5 File(s)      6528 bytes free

[D]
```

△ **Figure 1.** An MS-DOS standard interface. ▽ **DOS** between you and the machine.

Phil Cohen

the screen; when you move it to the right the pointer moves to the right of the screen, and so on.

By moving the pointer around, and then pressing a button on the top of the mouse, you can select various things from the screen, and tell the DOS what to do that way. Although the user interface is radically different, the functions that the DOS provides are exactly the same.

Programs

But interacting with the user is only part of what a DOS does. The other important part of its job is in interacting with programs running on the computer.

Files can hold either data (as in the case of the MAILLIST file), or actual programs which can be loaded (read from disk and put into RAM) and run by the use of DOS commands. In Figure 1, the file WS COM is a common word processing program called 'WordStar' (which in fact, I am using to write this article!). Typing the simple command ws into the DOS would cause it to load the WordStar program file in RAM and start running that program. The DOS would stay in another part of RAM all the time, so that when WS COM was finished, it would give the [D] prompt again, ready for the next command.

WordStar itself talks directly to the DOS; while running WordStar, I can call up a text file for editing. When this happens, WordStar asks the DOS for the characters in that file one at a time, and as they are passed back to WordStar it puts them on the screen.

When a program demands putting information into a file or creating a new file, or even putting a character onto the screen, it does it through the DOS.

Interactions between programs and DOS are done via the DOS entry points, which are particular addresses in RAM. To put a character into a file, for example, the character is placed in a particular part of RAM which then starts running the DOS program at the entry point. In the DOS at that entry point is a little program to put the character into the file.

When the character has been put into the file, the DOS passes control back to the program, which means very simply that it starts running the program (WordStar, for example) at the point at which it jumped to the DOS entry point.

Glossary

Create: to make a directory entry for a file

DOS: Disk operating system.

DOS entry point: a particular point in RAM where a part of the DOS program starts which can perform various functions needed by other programs.

Delete: same as 'Erase'.

Directory: part of the disk which holds details of all of the files on the disk, and what parts of the disk each file uses.

Erase: to remove the directory entry for a particular file.

File: an area of a disk which has been allocated a name by the user.

Filename: the name given by the user to a particular file.

Free space: how much space on the disk is not already allocated to files.

List: put a copy of a file, or a directory, on the screen.

Load: read a program (stored in the form of a file) from a disk and put it into RAM.

Mailing list: a list of names and addresses used for printing labels for envelopes.

Memory-resident: a term used to describe a program that stays in RAM the whole time.

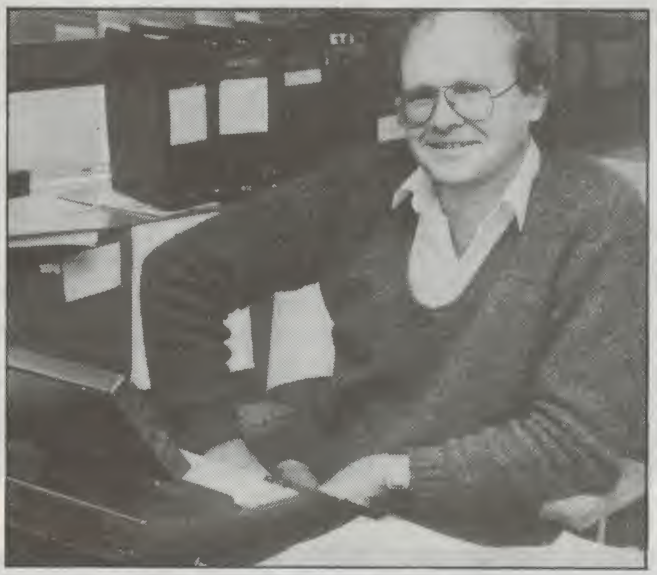
Mouse: a device for controlling the movement of a pointer on the computer screen.

Pass control: to start running another program.

Prompt: a short message at the start of a line which tells the user that the program (or DOS) is ready for the next command.

Rename: change the name of a file without altering the file itself.

User interface: that part of a DOS which takes commands from the user. ●



ONE OF THE JOYS of being appointed editor is that it's a chance, finally, to tell people what you think. In future issues I promise to offer thoughts on the most diverse of electronic subjects. For starters though, it's probably a good idea to be a little narcissistic and offer some thoughts on this magazine. A new editor is a chance for a new editorial policy. Off with the old and on with the new!

Let me say at the top that ETI is about readers. We want you to read us, the more the merrier. We want to interest you, inform you and generally make you await the next issue with bated breath.

We are about the new. We will not regurgitate last year's amplifier circuit, or even last year's idea of what an electronics magazine should look like. Here you will see tomorrow's ideas, not only in our circuits, but in every aspect of electronic life.

We want a magazine that appeals to the widest possible cross-section of people with any kind of interest in electronics at all. That includes people who fiddle with bits and pieces on a Saturday arvo, technicians who fiddle with them every day, engineers who don't have the time to fiddle any more, and captains of industry, who never fiddled, but like making money out of all that fiddling around.

We want to keep you informed about the world of electronics in all its wonderful diversity. In these pages you will find the itty-bitty of circuit technique and the broad sweep of industry policy, the latest systems developments as they happen as well as conjecture on possibilities of the future.

And the possibilities of the future are limited only by the quality of your dreams.

Above all else, we want to be part of the renaissance of electronic engineering that's taking place in Australia and New Zealand. We will be first with news of Australasian designs and achievements.

For example: in this issue we explore promising new Australia.. designs being developed at the University of New South Wales and Mt Stromlo observatory, test a new Australian amp (is it better than the Kiwi efforts?), deliver a new circuit using Rockwell's FORTH, look at financing high tech and step inside MIDI. And more, more, more!

So, if you want to get with the strength, get with us. All the rest is merely history.

Jon Fairall
Editor

Letters to the Editor

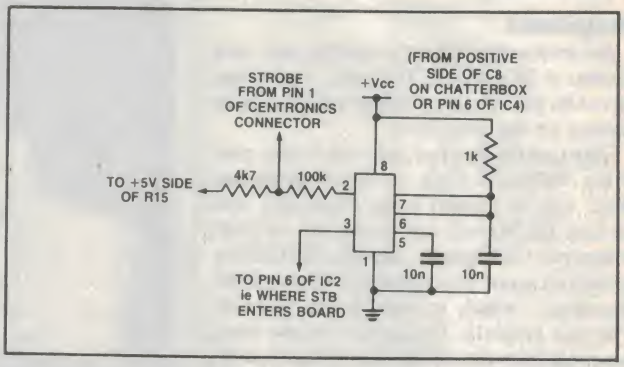
Changes for the Chatterbox

WITH REGARD TO the Chatterbox, project 677 (Jan 85), the Centronics connections listed on page 76 are incorrect: the STB line (RDY Microbee) to pin 6 of IC2c should be connected to pin 1 of the Centronics plug *not* as listed; and the BSY line should be connected to pin 11 of the plug *not* pin 1 as listed.

I found the STROBE pulse of the Centronics port (I have a CAT computer) insufficient to drive the Chatterbox. I am uncertain why but I think the pulse was both too short and too small voltage-wise. I finally got it going using a 555 triggered by the STROBE line from the port and delivering a 10 μs pulse to the Chatterbox. The circuit is shown herewith. Note that the links still need to be changed for Centronics type input.

Finally, thank you for an excellent publication. Keep it up.

John Loadsman,
Nowra, NSW



Keeping standards

I READ WITH interest the article describing a low cost frequency standard, the ETI-174, July 86.

You may be interested in some information which follows logically from the article. If a counter is driven by the source described and with a small number of other bits and pieces, the line rates of the other television stations can be measured.

To within the resolution of the set-up I have arranged and using the ABC as a reference, the line rates of the other Melbourne services are:

ABC 2 15625.0000 Hz (reference)
HSV 7 15625.0006 Hz
GTV 9 15625.0000 Hz
ATV 10 15625.0058 Hz
SBS 28 15625.0000 Hz

ATV 10 is the only station that is off frequency and hence any of the others could be used as a reference.

It is also possible to measure the differences between the line rates another way. Some years ago I did this and found that the difference between the ABC and GTV 9 was about five parts in 10^{11}. This is about 30 nHz and can be neglected for most purposes. It is easier to get a feeling for the difference by saying that it is about 5 Hz in 10 GHz.

Charles Edmond VK3AFV
Melbourne, Vic

Shots in the park

MY PROBLEM IS one of losing arrows when I play at my favourite sport. Occasionally at long range, arrows pass the target and disappear into the grass. Although they may be only from 10 to 60 millimetres below the surface it may as well be 10 to 60 metres. At $8 per arrow plus labour in making them this is becoming a pain in the rear. Yesterday I lost two.

The arrows are made from tubular aluminium 7.7 mm diameter and 795 mm length. I recently found an old project ETI-566 (April 80) pipe and cable locator. Is it a good idea and if so, where can I buy a kit or the bits?

Doug Sinclair,
Rozelle, NSW

See Shoparound on page 71 of the April 1980 issue. We can't find anyone selling a complete kit. As to whether it's a good idea: I dunno. Why not use the flight of the arrow to drive a propellor driven dynamo which could charge a large capacitor. On impact, a discharge cycle could drive a piezo alarm for a few seconds so you could locate the arrow by its noise!! — *Ed*

Calling on designers

PROWLING THROUGH DICK SMITH sometime back, I spotted your publication *Projects for your Car* (1985). I have already completed the Fluid Level Detector, Courtesy Light Delay and Windscreen Wiper Control Unit to my satisfaction.

While I was making the latter device, a problem that bugs turbo diesel owners, myself included, came to mind. After a turbine has been working, it is recommended that the engine be left idle at zero boost for up to two minutes depending on how hard it has been working. This is necessary to prevent the oil vapour which lubricates the turbine from 'cooking' and eventually clogging the bearings.

Now I've installed a vacuum gauge so that I can keep an eye on the situation and assess how long to leave the motor idling. However, it is not always possible to sit and wait for the time I think is necessary.

What is needed is a timing unit which is wired into the ignition circuit so that, when they key is turned off, the engine continues to idle for the selected period. It should be adjustable in 30 second steps up to two minutes. Further it should also incorporate an isolation switch so that it can be overridden during tune-up.

Surely you have a boffin on tap who could sort this one out. Don't forget that turbine engine boosting is becoming the norm so that it will make a desirable addition for the next issue of your booklet.

In conclusion, I've had a ball working on the projects I've already completed as well as producing useful articles. My only regret is that I haven't kept tabs on the developments in electronics since my wartime service. I guess I can't do everything.

F. Martin,
Eltham, Vic

— any boffins want to contribute a circuit?

— *Ed*

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TECHNICAL ENQUIRIES: No enquiries by telephone will be accepted. Readers have two options: to submit a written enquiry with $5 money order or cheque and receive a postal reply; this service is limited to projects published within the last five years; alternatively they may forward enquiry without money and expect a published reply in the Feed Forward columns at the editor's discretion.

CONTRIBUTIONS: Submissions must be accompanied by a stamped, self-addressed envelope. The publisher accepts no responsibility for unsolicited material.

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CLUB CALL

Announcing the **VZ200/300 User Group** which hails from the postal address PO Box 316, St Kilda, Vic 3182. Those interested in joining could contact Scott Le Brun.

For those with Tandy computers there is a **TRS-80 model 1 & 3, System 80, Tandy colour computer group.** For "80-Gamer" club newsletter, contact operator Jim Fisher, 37 Fairbairn Ave, West Pennant Hills, NSW 2120; for "Cass-Gamer" contact operator, Craig Tollis, PO Box 584, Port Macquarie, NSW 2444.

The **Microcomputer Users Group** of Alice Springs (MUGAS) has interest groups which cover Apple, Commodore, IBM-PC compatibles and CP/M compatible computers as well as a digital communications group which covers RTTY, AMTOR, Morse and packet radio. Basic membership to the club is $15 which covers a newsletter and access to all groups. A remote access system run in conjunction with the club is available to all on (089) 52-8852. More details can be obtained by writing to PO Box 3290, Alice Springs or contacting Mark Little on (089) 52-8230. ▶

Help! Unfortunately this month we didn't find a entry suitable for the "Idea of The Month" award. To all of our experimenting readers, send in your ideas but keep them short, keep them simple and keep them clever.

Baby pacifier

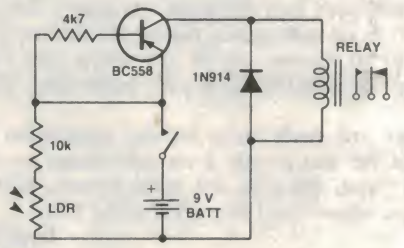
This circuit, designed by **J.J. Schutz** of **Camden Park, SA**, provides a distraction for a screaming infant in a cot. When the baby starts to cry, the circuit is triggered and an array of LEDs in the form of a mobile hanging out of reach above the cot starts flashing in sequence. The LEDs flash for four seconds or so, then stop until retriggered.

The circuit consists of a small speaker acting as a microphone. The signal from the speaker is amplified by IC1 which is a 741 op-amp. The input sensitivity is set by RV1. The output signal from IC1 triggers IC2 which is a 556 dual timer. One of the timers is configured as a monstable and the combination of R4 and C4 sets the time for which the mobile flashes.

The output from the timer mentioned above enables the second timer which is arranged as an oscillator. The flashing speed for this oscillator is set by R5, R6 and C6. The output from the second oscillator clocks IC3, which is a 4017B decade counter. The outputs from IC3 light up the different coloured LEDs in sequence.

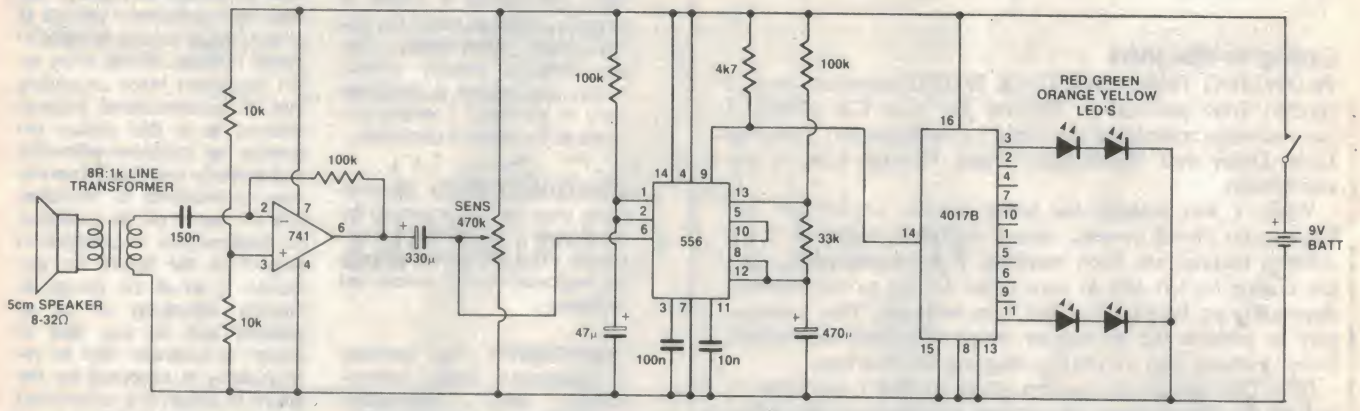
A variety of colours are used to create an interesting mobile.

Light activated switch



S. Carney of **Corrimal, NSW** sent us this light activated switch circuit. The switch is operated by shining light on to a light dependent resistor (LDR).

When the LDR is exposed to light, the BC558 pnp transistor turns on and energises the coil of the relay, thus closing the relay's contacts. When the light is removed from the LDR the transistor turns off and the coil of the relay de-energises via the 1N914 diode, and the relay's contacts open.



Club Data

Brian Horrocks, Paralowie, SA 5108

"CLUBDA", (CLUB DATA), is a program that has been devised to help club secretaries to maintain records of club members. It is a ROM-based program which does not lend itself to speedy operation, however, there are still a great number of people out there who are dying to see a new use for their diskless Microbees besides playing games.

This program allows input of the club name, year of current account, and relevant financial year, before displaying the main menu. It then supports display, editing, and printing of records, the insertion of new records, as well as printing address labels. Naturally it also permits the saving and loading of data.

In order to be useful, the program needs a 32K machine at least.

```
00100 REM #### CLUB RECORDS ####
00110 REM ## AUTHOR... Brian Horrocks  ##     DATE...26/8/85
00120 REM ## COPYRIGHT.....26/8/85 ##
00130 REM ## This program allows the maintenance of typical sporting club record
s. ##
00140 GOTO 190
00150 CLS:PRINT"INVALID SELECTION...TRY AGAIN":GOTO1640
00160 CLS:PRINT"INVALID SELECTION...TRY AGAIN":GOTO 300
00170 A1$=KEY$:IF A1$=""THEN 170
00180 RETURN
00190 POKE 220,111:STRS (9000)
00200 REM ### Set clearing variables for edit routine ###
00210 N6$=""                                    ":N4$="          ":N3$="          ":N2
$="  "
00220 DIMDO$(100,12)
00230 CLS:INPUT"Enter Club Name..";N1$
00240 PRINT: INPUT"Year of Account..";N2$
00250 PRINT: INPUT"End of Financial Year..";N3$
00260 GOTO 280
00270 CLS:CURS 527:INPUT"Computer Number Required...";Z:GOTO 440
00280 I=0
00290 REM #### Main  Menu ####
00300 OUT#1 OFF:CLS:CURS 151:PRINT"OPTIONS AVAILABLE"
00310 CURS 215:PRINT"-----------------"
00320 PRINTTAB25;"(1).ADD RECORDS"
00330 PRINTTAB25;"(2).DISPLAY A RECORD"
00340 PRINTTAB25;"(3).EDIT A RECORD"
00350 PRINTTAB25;"(4).SAVE DATA"
00360 PRINTTAB25;"(5).PRINT A RECORD"
00370 PRINTTAB25;"(6).LIST OF MEMBERS"
00380 PRINTTAB25;"(7).INSERT NEW RECORD"
00390 PRINTTAB25;"(8).LOAD DATA"
00400 PRINTTAB25;"(9).PRINT LABELS"
00410 PRINT:INPUT"SELECT OPTION..";A
00420 IFA<1ORA>9THEN160
00430 ONAGOTO 460,1060,650,1430,1050,1250,270,1320,1850
00440 I=Z-1
00450 REM ### Input Data for records ###
00460 CLS:I=I+1:INPUT"Name..";D0$(I,1)
00470 IF LEN(D0$(I,1))>22THEN 2300
00480 IF LEN(D0$(I,1))<3THEN 2300
00490 GOSUB 1640
00500 CLS:INPUT"M.A.A.A. Number...VH";D0$(I,2)
00510 INPUT"No./Street..";D0$(I,3):INPUT"Suburb..";D0$(I,4):INPUT"State/Post Cod
e..";D0$(I,5)
00520 INPUT"Phone Number..";D0$(I,8)
00530 INPUT "Financial Until..";D0$(I,7)
00540 PRINT "Member Status..";D0$(I,6)
00550 INPUT "Club Fees..$";F1
00560 INPUT"Joining Fee..$";J1:INPUT"S.A.A.A. Fees..$";S1
```

```
00570 DO$(I,9)=STR$(F1+J1+S1)
00580 PRINT:CLS:PRINT"TOTAL...$";DO$(I,9)
00590 PRINT:PRINT "Press any Key to Continue"
00600 L1$=KEY$:IFL1$=""THEN 600
00610 R=I
00620 GOTO300
00630 OUT#1 OFF:CLS:CURS530:PRINT"There may not be any Records.":PLAY0,30
00640 GOTO300
00650 REM $$$ EDIT ROUTINE $$$
00660 CLS:CURS5,7:INPUT"Which Record No. would you like...";F
00670 ON ERROR GOTO 630
00680 CLS:CURS1,1:PRINT"1--Name..";DO$(F,1)
00690 CURS1,2:PRINT"2--M.A.A.A. Number...VH";DO$(F,2)
00700 CURS1,3:PRINT"3--No./Street...";DO$(F,3)
00710 CURS1,4:PRINT"4--Suburb...";DO$(F,4)
00720 CURS1,5:PRINT"5--State/Post Code...";DO$(F,5)
00730 CURS1,6:PRINT"6--Member Status..";DO$(I,6)
00740 CURS1,7:PRINT"7--Financial until..";DO$(F,7)
00750 CURS1,8:PRINT"8--Computer Number..";F
00760 CURS1,8:PRINT"8--Phone Number..";DO$(F,8)
00770 CURS1,9:PRINT"9--Computer Number..";F
00780 CURS1,13:INVERSE:INPUT"Enter Line No. to Edit..or 'E' to Exit..";X7$:NORMA
L
00790 IF X7$="E"OR X7$="e" THEN 1020
00800 H=INT(VAL(X7$))
00810 IF H<10RH>5THEN 1020
00820 CURS1,13:PRINT"
                    "
00830 CURS1,11:PRINT"
                    "
00840 ON H GOTO 850,870,890,910,930,950,970,990
00850 CURS1,11:INPUT"New Name..";DO$(F,1)
00860 CURS10,1:PRINTN6$:CURS10,1:PRINTDO$(F,1):GOTO780
00870 CURS1,11:INPUT"New M.A.A.A. Number..VH";DO$(F,2)
00880 CURS 24,2:PRINT N4$:CURS24,2:PRINT DO$(F,2):GOTO 780
00890 CURS1,11:INPUT"New No./Street..";DO$(F,3)
00900 CURS 17,3:PRINT N6$:CURS17,3:PRINTDO$(F,3):GOTO 780
00910 CURS 1,11:INPUT"New Suburb..";DO$(F,4)
00920 CURS 13,4:PRINT N6$:CURS13,4:PRINT DO$(F,4):GOTO 780
00930 CURS 1,11:INPUT"New State/Post Code..";DO$(F,5)
00940 CURS 22,5:PRINT N6$:CURS22,5:PRINT DO$(F,5):GOTO 780
00950 CURS 1,11:INPUT"Member Status..";DO$(I,6)
00960 CURS 19,6:PRINT N6$:CURS19,6:PRINT DO$(I,6):GOTO 780
00970 CURS 1,11:INPUT"Financial Until..";DO$(F,7)
00980 CURS 21,7:PRINTN6$:CURS 21,7:PRINTDO$(F,7):GOTO 780
00990 CURS 1,11:INPUT"New Phone Number..";DO$(F,8)
01000 CURS 18,8:PRINTN6$:CURS18,8:PRINTDO$(F,8):GOTO780
01010 CURS 1,9:PRINT"Computer Number...";F
01020 CURS1,13:INVERSE:PRINT"Do you have another Member to update ? (Y or N) ":N
ORMAL
01030 U3$=KEY$:IFU3$="" THEN1030
01040 IF U3$="Y"ORU3$="y" THEN650 ELSE 300
01050 CLS:CURS 10:INPUT"Which Record No. would you like..?";F:OUT#1 ON:GOTO1070
01060 CLS:CURS 10:INPUT"Which Record No. would you like..?";F
01070 CLS:PRINTTAB10;N1$;" Record."
01080 PRINT
01090 ON ERROR GOTO 630
01100 PRINT
01110 PRINTTAB10;"NAME...";DO$(F,1)
01120 PRINTTAB10;"ADDRESS...";DO$(F,3)
01130 PRINTTAB20;DO$(F,4)
01140 PRINTTAB20;DO$(F,5)
01150 PRINTTAB10;"TELEPHONE No...";DO$(F,8)
01160 PRINTTAB10;"M.A.A.A. NUMBER...VH-";DO$(F,2)
01170 PRINTTAB10;"MEMBERSHIP STATUS...";DO$(F,6)
01180 PRINTTAB10;"FEES APPLICABLE...$";VAL(DO$(F,9))
01190 PRINTTAB10;"FINANCIAL UNTIL...";DO$(F,7)
01200 PRINTTAB10;"COMPUTER NUMBER...";F
01210 OUT#1 OFF
01220 PRINT:PRINTTAB5;"Press any key to continue.."
01230 U3$=KEY$:IFU3$=""THEN 1230
01240 GOTO 300
01250 ON ERROR GOTO 630:CLS:OUTL#1 ON:LPRINTTAB5;N1$;"  Membership List..":LPRIN
T
01260 LPRINT"LIST";:LPRINTTAB9;"NAME";:LPRINTTAB32;"DISTRICT";:LPRINTTAB57;"PHON
E";:LPRINTTAB68;"M.A.A.A.":LPRINT
01270 FOR S=1 TO R
01280 LPRINT S;:LPRINTTAB 5;DO$(S,1);:LPRINTTAB30;DO$(S,4);:LPRINTTAB56;DO$(S,8)
;:LPRINTTAB68;"VH-";DO$(S,2)
01290 NEXT S
01300 OUTL#1 OFF
01310 GOTO 300
01320 REM$$$LOAD FILE$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
01330 CLS
01340 GOSUB 1590
01350 IN#3:OUT#0OFF
01360 INPUTZ7$:IFZ7$(;1,5)<>"$$$$$"THEN 220
01370 C1$=Z7$(;11,16):R=INT(VAL(Z7$(;6,10))):POKE61440+R,13
01380 FORI=1TOR:INPUTZ7$,DO$(I,1),DO$(I,2),DO$(I,3),DO$(I,4),DO$(I,5),DO$(I,6),D
O$(I,7),DO$(I,8),DO$(I,9)
01390 IFINT(VAL(Z7$))<>ITHENNEXT$ I 1420
01400 POKE61439+I,9:NEXTI:IN#0:OUT#0
```

Multigraph

John Halar,
Ryde, NSW 2112

This program plots various 2D maths functions supported by MicroWorld BASIC. It works by asking you to input the function, the range of the function and the increment. The program can look at any section of a curve. You can specify the ranges again by pressing <C> when the plot is done. It then pokes the function to a line number using BASIC tokens and other necessary characters. Multigraph's limitations lie only in BASIC itself.

One word of WARNING: Do not edit, add or delete any lines of text before line 760 as it will cause the program to crash. If you wish to modify any lines, note the memory location of line 760 so that the function may be poked at the correct location.

```
00100 REM -------- Written by John Halar 1984 --------
00110 REM ---------------- Instructions ----------------
00120 CLS
00130 UNDERLINE:CURS 25,1:PRINT "MULTI - PLOT" :NORMAL
00140 PRINT\"     This program is designed to plot any mathematical function.The
 function to be plotted is simply typed in when prompted for."
00150 PRINT"However, the function must be typed in with the correct syntax  and
must be in the form of 'Y=.....X' and only the right hand  side is entered."
00160 PRINT"     e.g."
00170 PRINT TAB(15)"y= x+2 would be typed in as 'X+2'"
00180 PRINT TAB(15)"y= sin x ..................'SIN(X)'"
00190 PRINT TAB(15)"y= exp x ..................'EXP(X)'"
00200 PRINT"The negative and positive extremes and the increment of each"\"axis
is entered. A bell will sound when the graph is complete,"
00210 PRINT"and you will have the option to press <ESC> to enter another"\"funct
ion, <C> to change plot extremes and increment or <E> to   end."
00220 CURS 18,16:PRINT"PRESS <RETURN> TO BEGIN PLOT"
00230 IF KEY$<>CHR$(13) THEN 230
00240 CLS:CLEAR:POKE 257,2:REM lock key disable
00250 FOR T=1 TO 40:POKE 5008+T,32:NEXT T
00260 REM  ------------------ INPUTS ----------------------
00270 UNDERLINE:CURS 25,1:PRINT "MULTI - PLOT":NORMAL
00280 PRMT(=):T=0:CURS 3,4:INPUT "Input the Function : Y";A1$
00290 F1$=A1$
00300 T=T+1:E1$=A1$(;T,T)
00310 IF E1$="" THEN 340 ELSE IF E1$="X" THEN 320 ELSE 300
00320 E1$=A1$(;1,T-1):E2$=A1$(;T+1,LEN(A1$))
00330 A1$=E1$+"Z2"+E2$:T=T+1:GOTO 300
00340 CURS 3,7:INPUT"(X - Axis) Left extreme,Right extreme,Interval : ";X1,X2,I1
00350 CURS 3,10:INPUT"(Y - Axis) Left extreme,Right extreme,Interval : ";Y1,Y2,I
2
00360 REM ------------------- POKEING ----------------------
00370 C=0:D=0
00380 C=C+1
00390 A2$=A1$(;C,C):IF A2$="" THEN 550
00400 IF A2$="S" THEN 380 ELSE IF A2$="C" THEN 470
00410 IF A2$="A" THEN 380 ELSE IF A2$="T" THEN 480
00420 IF A2$="B" THEN 490 ELSE IF A2$="L" THEN 500
00430 IF A2$="E" THEN 510 ELSE 440
00440 IF A2$="I" THEN 460 ELSE IF A2$="Q" THEN 520
00450 GOTO 530
00460 B=211:C=C+1:GOTO 540
00470 B=212:C=C+1:GOTO 540
00480 B=213:C=C+2:GOTO 540
00490 B=203:C=C+1:GOTO 540
00500 B=214:C=C+2:GOTO 540
00510 B=215:C=C+3:GOTO 540
00520 B=210:C=C+1:GOTO 540
00530 B=ASC(A2$)
00540 D=D+1:POKE 5008+D,B:GOTO 380
00550 REM ---------------- AXIES  -------------------------
00560 HIRES:PLOT 97,0 TO 97,244
00570 CURS 1,2:PRINT"Function":CURS 1,3:PRINT "Y="F1$:CURS 1,8:PRINT "Y/Incremen
t":CURS 4,9:PRINT"="I2:CURS 1,6:PRINT "X/Increment":CURS 4,7:PRINT"="I1
00580 X1=ABS(X1):X2=ABS(X2):Y1=ABS(Y1):Y2=ABS(Y2)
00590 X3=400/((ABS(X1)+ABS(X2))/I1)
00600 XO=(X1/I1*X3)+106
00610 PLOT INT(XO),0 TO INT(XO),250
00620 Y3=244/((ABS(Y1)+ABS(Y2))/I2)
00630 YO=Y1/I2*Y3+6
00640 PLOT 105,INT(YO) TO 511,INT(YO)
00650 L1=XO-(X1/I1*X3):R1=X3*((X1/I1)+(X2/I1))+L1
00660 FOR T1=L1 TO R1+2 STEP X3
00670 SET INT(T1),INT(YO+1):SET INT(T1),INT(YO+2):NEXT T1
00680 L2=YO-(Y1/I2*Y3):R2=Y3*((Y1/I2)+(Y2/I2))+L2+1
00690 FOR T1=L2 TO R2  STEP Y3
00700 SET INT(XO+1),INT(T1):SET INT(XO+2),INT(T1):SET INT(XO+3),INT(T1):NEXT T1
00710 REM
00720 REM  ------------------- X-LOOP -------------------------
00730 N=0:Z1=103
00740 Z1=Z1+3:IF Z1=>509 THEN 880
00750 Z2=(Z1-XO)/X3:Z2=Z2*I1
00760 Y1=
00770 Y1=(Y1/I2*Y3)+YO
00780 ON ERROR GOTO 800
00790 IF Y1<=250 OR Y1>=6 THEN 810
00800 N=0:GOTO 860
00810 IF N=0 THEN 840
00820 PLOT INT(Z1),INT(Y1) TO W,V:N=1:W=INT(Z1)
00830 V=INT(Y1):GOTO 860
00840 PLOT INT(Z1),INT(Y1) TO INT(Z1),INT(Y1):N=1
00850 W=INT(Z1):V=INT(Y1)
00860 GOTO 740
00870 REM ------------- Prompts for inputs --------------------
00880 PLAY 23,1:PLAY 23,1
00890 P=ASC(KEY$):IF P=27 THEN 240 ELSE IF P=69 THEN 930
00900 IF P=67 THEN CLS:GOTO 340
00910 GOTO 890
00930 PLAY 23,1:CLS:END
```

```
01410 CLS:PRINT C1%:PLAY 9:GOTO 300
01420 IN#0:OUT#0:CURS960:PRINT "BAD LOAD": PLAY 9,3:GOTO 300
01430 REM$$$SAVE FILE$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
01440 CURS 960:INPUT "Enter a six letter file name ";Z7$;
01450 Z7$=Z7$+"XXXXXX":C1%=Z7%(1,6)
01460 GOSUB 1590
01470 POKE 61440+R,13
01480 OUT#3
01490 PRINT "$$$$$$";[15 R];C1%
01500 FORI=1TOR
01510 PRINT [15 I];",";
01520 PRINT D0$(I,1);",";D0$(I,2);",";D0$(I,3);",";D0$(I,4);",";D0$(I,5);",";D0$
(I,6);",";D0$(I,7);",";D0$(I,8);",";D0$(I,9)
01530 POKE 61439+I,9
01540 PLAY 0,4
01550 NEXT I
01560 PRINT "0,0,0,0,0,0,0,0"
01570 OUT#0:PLAY 23;23
01580 GOTO 300
01590 REM $$$ START TAPE $$$
01600 CURS 960:PRINT"START TAPE RECORDER & PRESS <RETURN> ";
01610 Z7$=KEY:IF Z7$=""THEN 1610
01620 PLAY 23:RETURN
01630 REM $$$ Membership Status selection Menu $$$
01640 CLS:CURS 151:PRINT"MEMBERSHIP STATUS"
01650 CURS215:PRINT"------------------"
01660 PRINTTAB25;"(1).FLYING"
01670 PRINTTAB25;"(2).ASSOCIATE"
01680 PRINTTAB25;"(3).JUNIOR"
01690 PRINTTAB25;"(4).PENSIONER"
01700 PRINTTAB25;"(5).LIFE MEMBER"
01710 PRINTTAB25;"(6).HONORARY LIFE MEMBER"
01720 PRINTTAB25;"(7).SOCIAL MEMBER"
01730 PRINT:INPUT"SELECT APPLICABLE STATUS..";B
01740 IF B<1ORB>7 THEN 150
01750 ON B GOSUB 2160,2170,2180,2190,2200,2210,2220
01760 RETURN
01770 REM $$$ Centralise $$$
01780 PRINT TAB(64-LEN(Z7$))/2;Z7$:RETURN
01790 REM  $$$ Label Printing Menu $$$
01800 CLS:PRINT:READ Z7$:GOSUB 1770
01810 READ Z,T:FOR I=1 TO Z:READZ7$
01820 PRINT TAB(T);Z7$
01830 NEXT I:RETURN
01840 REM $$$ PRINT $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
01850 ON ERROR GOTO 630:RESTORE 2240:GOSUB 1790
01860 GOSUB 2270:PRINT"SELECT OPTION  ";:GOSUB 2290
01870 Z=INT(VAL(Z7$)):IF Z<1 OR Z>4 THEN 1860
01880 CLS:IF Z=4 THEN 300
01890 ON Z GOSUB 1900,2000,1940:GOTO 1850
01900 Z=0:PRINT:FOR I=1 TO R
01910 PRINT"@";I;TAB(6);D0$(I,1)
01920 Z=Z+1:IFZ=10 OR I=R:GOSUB 2270:GOSUB2280:CLS:PRINT:Z=0
01930 NEXT I:RETURN
01940 INPUT"Name....          ";D0$(0,1)
01950 REM
01960 INPUT"No./Street...    ";D0$(0,3)
01970 INPUT"Town or Suburb..";D0$(0,4)
01980 INPUT"State/Post Code.";D0$(0,5)
01990 G=0:F=0:GOTO 2020
02000 INPUT"Enter Start Name Number  ";S
02010 INPUT"Enter Finish Name Number  ";F
02020 INPUT"Quantity to be printed    ";Q
02030 INPUT"Printing TAB Position     ";T
02040 FOR J=S TO F
02050 FOR I=1 TO Q
02060 OUTL#1 ON
02070 LPRINT TAB(T);D0$(J,1)
02080 FOR K=3 TO 5
02090 LPRINT TAB(T);D0$(J,K)
02100 NEXT K
02110 LPRINT\\:REM $$$$$ adjust space to next label $$$$$
02120 NEXT I
02130 NEXT J
02140 GOTO 300
02150 REM $$$ Membership Status Subroutine $$$
02160 D0$(I,6)="Flying Member..":RETURN
02170 D0$(I,6)="Assoc. Member..":RETURN
02180 D0$(I,6)="Junior Member..":RETURN
02190 D0$(I,6)="Pensioner Member..":RETURN
02200 D0$(I,6)="Life Member..":RETURN
02210 D0$(I,6)="Honorary Life Member..":RETURN
02220 D0$(I,6)="Social Member..":RETURN
02230 REM $$$ Data for Label Printing Menu $$$
02240 DATA "LABEL PRINTER OPTIONS",5,15," ","1 - LIST ALL NAMES"
02250 DATA "2 - PRINT LABEL FROM LIST OF NAMES"
02260 DATA "3 - PRINT LABEL FROM DATA TO BE ENTERED","4 - QUIT"
02270 CURS C:PRINT[A63 32];:CURS C: RETURN
02280 PRINT"PRESS ANY KEY TO CONTINUE";
02290 Z7$=KEY:IF Z7$="" THEN 2290 ELSE RETURN
02300 CLS:CURS448:PRINT"Name Not to be Shorter Than 3 or Longer Than 27 Letters"
:PLAY0,35:GOTO 460
```

How much is a million

R. Wilkinson,
Nelson Bay, NSW 2315

```
00010 CLS
00020 PRINT"      .......HOW MUCH IS A MILLION......"
00030 PRINT"           14/4/84      By  R.Wilkinson."
00040 PRINT
00050 PRINT TAB (8)" MENU          LINE 200 -- DAYS IN HOURS,      No 1"
00060 PRINT TAB (20)" LINE 290 -- DAYS IN YEARS.      No 2"
00070 PRINT TAB (20)" LINE 380 -- DAYS IN SECS.       No 3"
00080 PRINT TAB (20)" LINE 470 -- MILES IN STEPS.     No 4"
00090 PRINT TAB (20)" LINE 560 -- GALS.IN DROPS P.M.  No 5"
00100 PRINT TAB (20)" LINE 650 -- GALS.IN DROPS       No 6"
00110 PRINT TAB (20)" LINE 740 -- REVS. FOR HRS.      No 7"
00120 PRINT:PRINT"INPUT '0'<RETURN> to go to MENU at any time through the LOOPS.
 To END Press <BREAK> then type GOTO 860 <RETURN>"
00130 PRINT [A64 126]
00140 PRINT
00150 PRINT "ENTER YOUR CHOICE, then press RETURN"
00160 INPUT N
00170 CLS
00180 ON N GOTO 200,290,380,470,560,650,740
00190 CLS
00200 PRINT "How many DAYS in (xxxx) Hours"
00210 PRINT
00220 FOR Z=1 TO 100
00230 INPUT "INPUT No. of Hours ?" X1%
00240 IF X1=0 THEN GOTO 10
00250 Y1=X1/24
00260 PRINT TAB (10)Y1%
00270 PRINT "=  DAYS "
00280 NEXT Z
00290 PRINT "How many DAYS in (xxxxx) Years"
00300 PRINT
00310 FOR L=1 TO 100
00320 INPUT "Number of Years ?"J1%
00330 IF J1=0 THEN 10
00340 H1=J1*365
00350 PRINT TAB (10)H1%
00360 PRINT "=  DAYS "
00370 NEXT L
00380 PRINT "How many DAYS in (xxxx) Seconds"
00390 PRINT
00400 FOR I=1 TO 100
00410 INPUT "INPUT No. of  Seconds ?" B1%
00420 IF B1=0 THEN 10
00430 C1=B1/60/60/24
00440 PRINT TAB (10) C1%
00450 PRINT "=   DAYS"
00460 NEXT I
00470 PRINT "How many MILES in (xxxx) steps  27 ins. long"
00480 PRINT
00490 FOR M=1 TO 100
00500 INPUT" No. of steps ?" A1%
00510 IF A1=0 THEN 10
00520  M1=A1/2246.6
00530 PRINT TAB(10)M1%
00540 PRINT "=  MILES"
00550 NEXT M
00560 PRINT "How many GALLONS at(xxxx)drops per min"
00570 PRINT
00580 FOR D=1 TO 100
00590 INPUT "Number of drops per minute ?" L1%
00600 IF L1=0 THEN 10
00610 F1=L1*60*24/90880
00620 PRINT TAB (5) F1%
00630 PRINT"= GALLONS per day"
00640 NEXT D
00650 PRINT "How many GALLONS in (xxxxxx) drops ?"
00660 PRINT
00670 FOR V=1 TO 100
00680 INPUT "No. of drops ?" S1%
00690 IF S1=0 THEN 10
00700 O1=S1/20*568/8
00710 PRINT TAB (10) O1%
00720 PRINT " = GALLONS "
00730 NEXT V
00740 PRINT "How many REVOLUTIONS for (xxxxxx) HOURS.?"
00750 PRINT
00760 FOR C=1 TO 100
00770 INPUT "No. of HOURS (at 1425 per min)"G1%
00780 IF G1=0 THEN 10
00790 Z1=G1*85500
00800 PRINT TAB (5) Z1%
00810 PRINT"=  Revolutions"
00820 NEXT C
00830 PRINT
00840 PRINT
00850 PRINT
00860 CLS
00870 CURS 6,10:PRINT TAB (15)"E N D  O F  P R O G R A M "
00880 CURS 20,12: UNDEFINED: PRINT "1000000   Mum "Big Fella"":NORMAL
00890 END
```

Broadway lettering

K. Hardy,
Macdonald, NSW 2255

This program changes all of the VIC 20's letters into fancy, Broadway style lettering.

Broadway lettering changes all of the upper case letters to broad lettering. This program takes 783 bytes to run, and will not work in lower case. It was written on a 6655 byte machine, but should work on an unexpanded VIC.

```
5 PRINT"{
5 PRINT" BROADWAY LETTERING
7 PRINT PRINT"    KEARON  HARDY."
8 REM
10 PRINT PRINT PRINT PRINT PRINT"------PLEASE WAIT.------"
20 POKE51,255:POKE52,28:POKE56,28:POKE55,255
25 POKE28869,255
30 FORI=0TO511
40 POKE7168+I,PEEK(32768+I):NEXT
50 FORI=0TO:?48-1:READA
59 IFA=-1THENEND
60 POKE 7168+I+I*8,A:NEXT
62 REM
110 DATA 60,98,98,126,98,98,98,0
120 DATA 124,98,98,124,98,98,98,124
130 DATA 60,98,98,96,96,98,98,60
140 DATA 124,98,98,98,98,98,98,124
150 DATA 126,96,96,124,96,96,96,126
160 DATA 126,96,96,124,96,96,96,96
170 DATA 60,98,98,96,110,98,98,60
180 DATA 98,98,98,126,98,98,98,98
190 DATA 60,24,24,24,24,24,24,60
200 DATA 62,6,6,6,6,38,38,28
210 DATA 98,98,100,120,104,100,98,98
220 DATA 96,96,96,96,96,96,96,126
230 DATA 98,118,106,98,98,98,98,98
240 DATA 98,114,106,102,98,98,98,98
250 DATA 60,98,98,98,98,98,98,60
260 DATA 124,98,98,124,96,96,96,96
270 DATA 60,98,98,98,98,106,100,58
280 DATA 124,98,98,124,104,100,98,98
290 DATA 60,98,96,60,6,98,98,60
300 DATA 126,24,24,24,24,24,24,24
310 DATA 98,98,98,98,98,98,98,60
320 DATA 98,98,98,98,98,98,52,24
330 DATA 98,98,98,98,98,106,106,52
340 DATA 98,98,52,24,28,38,70,70
350 DATA 98,52,24,24,24,24,24,24
360 DATA 126,6,12,24,48,96,96,126
400 DATA -1

READY
```

Cave Hunter

T. Bedelph,
Ulverstone, Tas 7315

Cave Hunter is an adventure game for the unexpanded Vic 20. The object of the game is to track down a deadly monster in a maze of 24 caverns and kill it with one of your acid sprays. There are also zombies, quicksand and bats to make things difficult.

If you enter the room containing the magic sword, then you become invincible to the monster, and the randomizer will transport you to a different cavern.

You begin the game with three sprays, and pick up more in certain rooms. To move from cavern to cavern, just enter one of the cavern numbers (printed under 'EXITS:'), and to fire, just enter '99', then the cavern number.

It helps to keep track of the caverns you have visited, so you can discover where the hazards are by a process of elimination.

```
100 POKE36879,235:PRINT""
105 SP=3
110 CP=0:M=INT(RND(1)*25)
111 QP=0
115 B=INT(RND(1)*25):Q=INT(RND(1)*25)
120 V=INT(RND(1)*25):Z=INT(RND(1)*25)
125 P=INT(RND(1)*25):R=INT(RND(1)*25)
200 PRINT"CAVERN";CP
201 PRINT"SPRAYS";SP
210 E1=INT(RND(1)*25):E2=INT(RND(1)*25):E3=INT(RND(1)*25):E4=INT(RND(1)*25)
215 PRINT"EXITS:-":PRINT"------"
220 PRINT"";E1,E2,E3,E4
221 IFR=CPTHENGOTO500
222 IFP=CPTHENGOTO530
223 IFV=CPTHENGOTO560
224 IFB=CPTHENGOTO460
225 IFM=CPTHENGOTO400
226 IFZ=CPTHENGOTO420
227 IFQ=CPTHENGOTO440
230 IFM=E1ORM=E2ORM=E3ORM=E4THENPRINT"MONSTER IS NEAR."
235 IFZ=E1ORZ=E2ORZ=E3ORZ=E4THENPRINT"ZOMBIE IS NEAR."
240 IFQ=E1ORQ=E2ORQ=E3ORQ=E4THENPRINT"QUICKSAND IS NEAR."
250 IFB=E1ORB=E2ORB=E3ORB=E4THENPRINT"BATS ARE NEAR."
300 PRINT"WHAT NOW?":INPUTA
305 IFA=E1ORA=E2ORA=E3ORA=E4THENCP=A:GOTO200
310 IFA=99THEN350
320 PRINT"CAN'T DO THAT."
330 GOTO300
350 PRINT"WHERE TO?":INPUTW
351 IFW=E1ORW=E2ORW=E3ORW=E4THENGOTO355
352 PRINT"CAN'T SHOOT THERE.":GOTO350
355 IFW=MTHEN2000
360 PRINT"MISSED.":SP=SP-1
365 IFSP=0THENPRINT"OUT OF SPRAYS.........":GOTO1000
370 FORY=1TO2000:NEXT:GOTO200
400 IFQP=1THENGOTO2000
402 PRINT"THE MONSTER IS HERE...IT KILLS YOU.........."
410 GOTO1000
420 PRINT"AAAGGGGGHHHHHH........THE ZOMBIE IS HERE...."
430 GOTO1000
440 PRINT"BLUBBER BLUBBER.......QUICKSAND IS HERE....."
450 GOTO1000
460 PRINT"BATS ARE HERE.........THEY CARRY YOU AWAY..."
470 FORY=1TO3000:NEXT:CP=INT(RND(1)*25):GOTO200
500 PRINT"THE RANDOMIZER IS HERE"
505 CP=M+1
510 PRINT"IT TRANSPORTS YOU....."
515 FORW=1TO3000:NEXT:GOTO200
530 PRINT"THE MAGIC SWORD IS    HERE................."
535 QP=1
540 GOTO300
560 PRINT"THERE IS AN EXTRA     SPRAY CAN HERE........"
570 SP=SP+1
580 GOTO300
1000 FORY=1TO3000:NEXTY:PRINT""
1005 FORJ=1TO300:POKE36879,RND(1)*24+8:POKE36876,RND(1)*10+240:NEXT:POKE36879,23
5
1007 POKE36879,235
1010 PRINT"GAME OVER"
1015 FORT=1TO2500:NEXT
1020 PRINT"ANOTHER GAME (Y/N)"
1030 GETA$:IFA$=""THEN1030
1035 IFA$="Y"THENCLR:RUN
1040 IFA$="N"THENPOKE36879,27:PRINT"":END
1050 GOTO1030
2000 PRINT""
2001 FORJ=1TO300:POKE36879,RND(1)*24+8:POKE36876,RND(1)*10+240:NEXT:POKE36879,23
5
2005 PRINT"CONGRATULATIONS!!!!!!!YOU KILLED THE MONSTER"
2010 FORY=1TO3000:NEXT
2020 GOTO1020

READY.
```


ETI READER SERVICE 22

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Contributors can look forward to $20 for each published idea/program which should be submitted with the declaration coupon below.

Programs MUST be in the form of a listing from a printer. You should indicate which computer the program is for. Letters should be typewritten or from a printer, preferably with lines double spaced. Circuits can be drawn roughly, because we have a draughtsman who redraws them anyway, but make sure they are clear enough for us to understand.

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'Idea of the month' contest

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a 60 W portable cordless soldering iron, a 240 V charging adaptor together with a holder bracket. The prize is worth approximately $100.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine.

RULES

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each coupon. Photostats or clearly written copies will be accepted. You may send as many entries as your wish.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

TOWARDS A BETTER MOUSETRAP

For the struggling inventor nurturing something more than a germ of an idea, the trail to market can be long, weary and confusing. One authority recently established to signpost the way is the management investment company.

Jon Fairall

AUSTRALIANS ARE an ingenious lot. We make contributions to the sciences, in engineering, as well as in the arts, out of all proportion to the size of our population.

How can it be then, as we face the home stretch of the twentieth century that we find our industries so old and inefficient, our ability to compete internationally so woeful? Are we indeed an embryonic banana republic?

It's a complex question and it deserves a more complex answer than we can give here, but in parts of industry, especially the electronic industry, the prevailing mood is far more optimistic. The question there is how can we rejuvenate industry.

In fact, there are signs around that we have moved beyond the questioning stage. Rejuvenation is already taking place. The financial press is full of the benefits of investing in high technology, and new means of financing the most arcane of products are appearing. In the first quarter of 1986 the Department of Trade, Industry and Commerce reported a rise in the level of private funding of R&D in Australia for the first time in memory.

History

What's happening? To put the story into context, we need to remember that ever since Australia was founded there has been little or no need to have a progressive manufacturing base. Our industries have always been derivative.

In the bad old days, strong reasons could be advanced for this state of affairs. Australia, with its small population could support little internal competition. Overseas manufacturers didn't provide any extra competition because of the tyranny of distance. It made no sense to be bold when new technology had to be introduced. In fact, it made much more sense to wait for others to develop new technologies, make their inevitable mistakes and find the solutions. Then we could move in and rake over the pieces.

In a slowly paced world it made good sense. But as communications got better, the costs of such a policy became more noticeable. Australians grew to resent a system which protected fat and lazy manufacturers while consumers lived in a world 10 years behind the advanced technology centres.

In 1974, when tariff protection ended, manufacturing industry, particularly electronics manufacturing, died overnight in the onslaught of foreign goods. The Australian population began a world class love affair with high tech, and accepted the higher levels of unemployment as a worthwhile price to pay. The conventional wisdom then was that we would get our money from a combination of service and

Of mice and men.

primary industries. Robots would do the dirty work in between.

Challenge

For a while it was a strategy that seemed to work. Mineral booms and high agricultural prices helped keep up appearances. But as the 80s dawned the bottom fell out of both markets, and all of a sudden bananas were the flavour of the week at every economics conference from Darwin to Hobart.

But it's not all doom and gloom. Many people are now working to create a new industrial base without recreating the problems inherent in our last attempt. Increasingly it is being recognised that the future wealth of the country must be built on the brain power of its people, on research into devices and processes that break new ground. As a result the need to invest in industries with a future is becoming more urgent.

There are many problems in doing this. Probably the most important is finding a way to provide a financial system that will allow the risk taking, losses and occassional profits that are part of being a leader rather than a follower. The answer is venture capital.

Venture capital

It's the weapon of choice for a government trying to build an industry. To understand venture capital, it's first neccessary to know the players. In the one corner are investors, people with money burning a hole in their pockets. In the other, innovators, people with no money, but a great idea. In between: the government. Its role is sometimes to protect one party or the other, sometimes to just stand there with its hand out.

These three players need to get together. The facilitator is the venture capitalist. The role of a venture capitalist is to make it possible for the investor to invest, the innovator to make use of the investment, and in so doing, to satisfy the aims of the government, whatever they might be.

Exactly how this works depends very much on where the venturer stands in the marketplace. The venture capital market is tremendously complicated. There are all kinds of government, quasi government and private organisations, all aiming themselves at different classes of innovators. They each require a different level of commitment by the vendor, expect different things and try to strike bargains of greater or less toughness.

Of men and money.

One can make some sense of it though. Roughly, there are three different types of situation which form a hierarchy in terms of the money held by the inventor, and the amount of thought he has given to marketing.

At the bottom are the government agencies. Often these are the first port of call for an investor with a hot little prototype clutched close to his chest. The agencies are short on cash, but long on advice.

What capital there is, is available in a variety of forms. For instance it can take the form of a loan or a loan guarantee, sometimes even a direct grant. However, Harold Graycar of the NSW Innovation Centre cautions that munificence is "as rare as hens teeth".

Far more common at this level are simple counselling services. Not only do government agencies employ people who can give advice on the most appropriate way to get a better mouse trap off the ground, they also do things like prepare business and financial plans, look at markets, suggest company structures and so on.

The beauty of these services is that they're available to people without any of their own money. So is the next level up, a group one can loosely describe as the innovation exploiters. These are commercial enterprises set up to look at ways of exploiting bright ideas. To interest such people you need a working prototype and a lot of persistence but not much else.

The way such companies work is that they provide the financial, business and organizational muscle, the inventor supplies the better mouse trap. The problem with such a relationship is usually that the inventor expects an unrealistic amount out of it. The innovation exploiter is in a very strong position. Money and business knowledge come with the territory. The vendor usually has neither. It doesn't take too much imagination to realise who has the upper hand.

Avoiding this situation is not easy. If all you have is a great idea, you must expect to pay other people to turn it into a practical production item. To make the relationship more even, the inventor must do his own homework, be prepared to soil his hands in the murky world of high finance. A business plan is essential, as is a market survey. In other words, you must know both how to manufacture a better mouse trap and how you intend to sell it.

Of course, manufacturing a mouse trap is considerably different from developing a prototype, and selling it is probably not as straightforward as the typical inventor thinks. Both exercises require specialists. One consistent message from everyone involved in the field is that getting a good team together is one of the first, and one of the most important things, an inventor ▶

needs to do.

So, given the invention, the team, the plan, what next? The third level of help is much closer to the real market place. There are a number of different types of organization here: second boards, management companies, merchant bankers and so on. Second boards are run by the stock exchanges as places in which companies can list, subject to much less restrictive regulations than in the regular stock exchange. The capital has to be less, the years of operation less, and the risks of failure, of course, commensurably higher. However, funding comes from the ordinary investor on the stock exchange, so the company is expected to perform on much the same basis.

The first second board was set up in Perth. It was a runaway success and some high tech glamour stocks listed on it. Big institutional investors jumped on the bandwaggon and the price of stocks skyrocketed. Not a few fortunes were made. However, it seems to have done the cause of high technology R&D very little good in the long run, because for every millionaire there are hundreds with holes in their pockets. As a result second boards seem a bit moribund at present.

Management investment companies

Rather more successful are the management investment companies (MICs). They were set up by the government in 1984 in response to the increasingly dismal level of private funding of high technology innovation. Since then the road has been somewhat rocky, and MICs have found plenty of critics.

However, to an increasing degree, MICs are where the money and the management expertise are located, so they must be doing something right.

MICs are venture capital companies. They seek a high return for funding risky high technology ventures. They take the funds of people who invest in the MIC, and buy a stake in worthwhile companies.

Since they share the success or failure of the companies they support, MICs are vitally concerned with the long term development of their ventures. As well as funds, they provide input into the managing board of the companies they support. In a typical situation, one of the members of the board of the MIC sits on the board of the company as well.

Returns are expected to be long term, but large. In fact, 10 year planning horizons may well be the norm.

MICs offset some of the risk by holding a portfolio of investments. They will all be high technology companies, but typically spread over a number of industries.

There are currently 11 MICs with a combined capital of $122m, presided over by a licensing board. It's the responsibility of the board to license and control the companies within the terms of an Act of parliament.

The most important elements of this control relate to ensuring that MICs carry out the functions for which they were established. For instance they must invest in companies worth less than $6m and employing less than 100 people. The companies MICs invest in must be less than 10 years old and show a significant amount of innovation in their choice of product.

Control is also important since MICs offer substantial tax advantages to investors. In fact all the money invested in an MIC can be deducted from tax. The possibility of abuse of this facility is so obvious, and control so tight, that no allegations of tax rorts have surfaced yet.

Of investment and reward.

MANAGEMENT INVESTMENT COMPANIES

Austech Ventures	9 Portman Pl, North Sydney 2060. (02) 922-2577.
Australian Pacific Technology Ltd	Level 25, City Mutual Building, 459 Collins St, Melbourne, Vic 3000. (03) 62-6481.
BT Innovation Ltd	3rd Floor, 60 Pitt St, Sydney, NSW 2000. (02) 27-5313
Continental Venture Capital Ltd	4th Floor, BMA House, 135-137 Macquarie St, Sydney, NSW 2000. (02) 27-2614.
CP Ventures Ltd	613 St Kilda Rd, Melbourne, Vic 3004. (03) 520-5333.
First LIC Ltd	Level 8, 2 Bligh St, Sydney, NSW 2000. (02) 221-4311.
SAMIC Ltd	28 Greenhill Rd, Wayville, SA 5034. (08) 271-6088.
Stinoc Pty Ltd	C/- Wilson International Pty Ltd, 24th Floor, 77 St George's Tce, Perth, WA 6000. (09) 325-4977.
Techniche Ltd	4th Floor, 410 Queen St, Brisbane, Qld 4000. (07) 221-6022. 4th Floor, 493 St Kilda Rd, Melbourne, Vic 3004. (03) 267-8766
Western Pacific Investment Co Pty Ltd	4th Floor, 395 Collins St, Melbourne, Vic 3000. (03) 614-5590.
Westintech Innovation Corp Ltd	Suite 8, Technology Centre, 2 Brodie-Hall Dr, Bentley, WA 6102. (09) 362-4688.

Enquiries about the program can be directed to:
Office of the MIC Licensing Board
Department of Industry, Technology & Commerce,
7th Floor,
339 Swanston St,
Melbourne, Vic 3000. (03) 665-6746 or 665-6846
or
Office of the MIC Licensing Board,
Department of Industry, Technology & Commerce,
Level 3,
Entrance 5,
Benjamin Offices,
Belconnen Town Centre, ACT 2616. (062) 64-4951 or 64-4955.

Critics

The tax concession to MICs amounts to money forgone by the country, so the question is often asked: does Australia get good value for its money?

A number of people argue that we do not, and not all of them are simply disgruntled innovators turned away by MIC boards. Mostly, criticism relates to the fact that MICs come in to bat too late in the game. Often it appears they begin funding only when a company is already up and running successfully.

They argue that the capital is really needed at the time when the inventor is trudging the streets with his mouse trap under his arm and not a sou to his name. MIC managers do not deny the problem, but they do defend the system. "We invest in businesses, not products," says John Grant of First MIC.

None of the MICs like the idea of talking to a man of the street with only a better mouse trap clutched tightly in his hand. MICs do not provide the ideas for manufacturing or marketing a product. "We are not interested in starting up companies ourselves," says John Paterson of Austec Ventures. He points out that the MIC industry only contains a total of 35 people spread across 11 companies. "Even if we wanted to we don't have the time." Anyone who has been through the experience will know that starting a company, even in low risk areas, is an 18 hour a day, seven day a week occupation that may last for years.

Nevertheless, are MICs too conservative in their assessment of companies? The portfolios of some of the MICs show a definite slant towards support for the glamour stocks of high tech. Western Pacific, for instance, lists Vision Systems (robots and lasers), Cochlear (bionic ears) and Scitec (modems) among its portfolio of seven investments. All are already highly successful. Jo Bloggs and the better mouse trap don't get a look in.

John Grant replies that First has never rejected a deal based solely on a risk assessment. Propositions are rejected because, in the opinion of the MIC, they don't have a future.

At this stage of the game it's difficult for MICs and their critics, much less journalists, to know what the truth is. MICs were only started in late 1984. For much of the intervening period they have been setting themselves up; trying to learn how to make realistic assessments of technology that is often unfamiliar. It has only been in the last year or so that things have really got going.

Preliminary surveys suggest that perhaps there is some truth in the allegations. None of the MICs report trouble getting funds. In addition, there have been only a few collapses of MIC-backed companies. This implies perhaps, that the risks are smaller and the profits higher than they should be. Certainly, local MICs are finding it easy, much easier than their contemporaries in the US or Europe, to identify good companies and turn them into money trees.

This is not as much of a indictment as it sounds. In the nature of the game, the MICs will initially invest in the proven stocks that fall within their definition of high technology companies as prescribed in the legislation. One would expect, over time, that the level of profit would come down and the number of failures go up as more MICs are established, and more deals concluded.

The ivory tower

Even so, the basic rules of MIC decision making are already fixed. MIC managers are far more interested in the quality of the people they support than the product. They are interested in results already obtained and in demonstrable future earnings.

They are not interested in the single inventor. When the government set up the MIC regulations, there was much talk of the lonely genius in his ivory tower at last meeting Mammon. But much was political rhetoric. MICs do not, and will not accomplish the meeting.

Should the government try to ensure that they do? Perhaps there is an argument for saying that the government should make initial seed capital available to start attractive businesses; the returns due to increased productivity would presumably make it financially worthwhile. This is the reasoning behind such loans and loan guarantees as are given out at the moment.

On the other hand, there is an argument which says that making the first round tough ensures that businesses are led by competent people. A strong venture capital sector will ensure that the rewards for making the initial plunge are worthwhile.●

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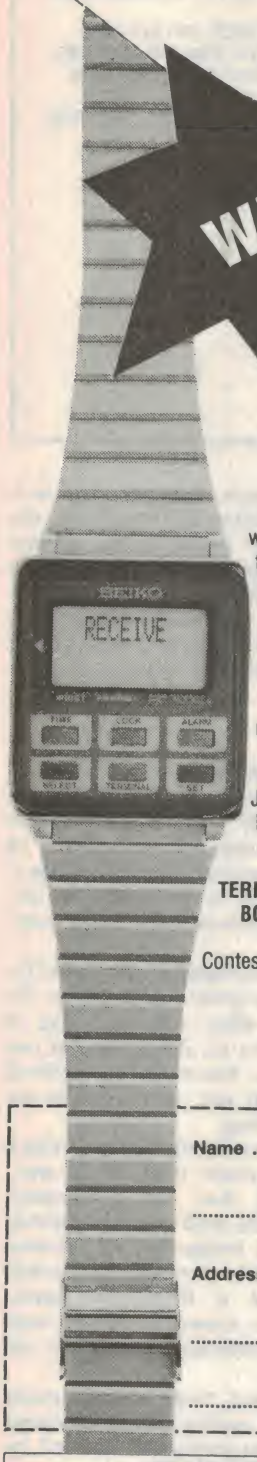

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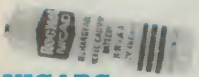

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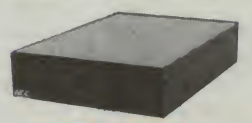

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Q10540	MU65 0-1mA	10.50	9.35
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Y11020	4.00MHz	HC18	1.30	.90
Y11022	4.194304MHz	HC18	1.40	.90
Y11025	4.75MHz	HC18	1.40	.90
Y11026	4.9152MHz	HC18	1.40	.90
Y11042	6.144MHz	HC18	1.40	.90
Y11050	8.00MHz	HC18	1.40	.90
Y11055	8.867238MHz	HC18	1.40	.90
Y11070	12.00MHz	HC18	1.40	.90
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LABTAM and the world's best etching machine

Unisearch, the University of New South Wales' commercial arm and Labtam International from Melbourne, have just signed a contract to develop a photolithographic chip etching machine. According to Chris Horwitz of the University of New South Wales, the yield and the quality of the work will be far superior to competitive machines, without any increase in price.

Jon Fairall

LABTAM IS currently setting in motion plans to manufacture the machine. A plant is being established at Braeside in Melbourne which will eventually supply the South East Asian and European markets that Labtam currently exploits. Market pushes into Japan and the US are also expected.

Labtam International has been around since 1972 when R&D Instruments was founded by Don Dryden and Heimo Eberhardt. R&D became Labtest, a company that imported lab equipment from overseas.

However, as time progressed, the people at Labtest started making alterations to the imported equipment, so as to improve their service to the customer. In fairly short order they were making entire pieces here, then designing them as well.

In 1975 Labtest began work on an inductively coupled plasma. Matched with suitable optical equipment, it offered a new solution to analysing elements in an unknown substance.

By 1983 Labtam International had become the biggest supplier of inductively coupled plasma to SE Asia and the USSR. Other orders have been received from Europe and Africa.

In fact one of the few countries where Labtam has made no impact is the US. That's been the result of a carefully considered policy which has put breaking into the chauvinistic US market in the 'too hard' basket, and left Labtam free to concentrate on other countries.

Not a terribly common philosophy of international marketing, but certainly one that has worked. Labtam is one of the top export earners in the high technology industries of Australia. Over 80% of its total sales goes overseas. It won both the Small Business and Export Awards of 1982. Sales topped $10m in 1985, and profit $600,000.

The key to all this is in R&D expenditure: $1.2m. To turn the Horwitz device into a viable commercial product will require still more.

The current technology for making practical integrated circuits starts with a process familiar to every pc board maker. The blank silicon wafer is coated with photoresist, a mask is placed over the top and the whole assembly exposed to ultra violet light. Then it's washed in a developer, and the exposed photoresist is dissolved away, leaving behind a protective layer only in the areas that are not to be etched.

The details of this process can vary. But no matter how it's done, the result will always be to protect certain areas and to leave others free. Another complexity is that the process has to be done in a number of different stages. A practical integrated circuit consists of several layers: there will be a substrate of silicon, and above it a sandwich of conductors and insulators. Each layer will need to be laid down, then etched, the next layer laid over the top and also etched, and so on until the complete circuit is built up.

Etching is accomplished by exposing the wafer to a plasma. A radio frequency (rf) generator is connected between a plate suspended inside an evacuated chamber, and the walls of the chamber. The plate is thus the cathode while the walls of the chamber act as the anode. The wafer to be etched is placed on the cathode.

Under conditions very close to perfect vacuum, the residual gas ionizes when subjected to rf, and forms a plasma. As the ions are attracted to the plate they hit the wafer, and eat away the silicon. This process is called sputter etching.

A sophistication of the basic process is reactive sputter etching, in which a residual gas containing flourine reacts with the silicon. This increases the rate at which the process happens, and also makes it possible to differentiate even more strongly between silicon, which reacts with the flourine, and the other layers like the resist, which do not.

The big problem with this whole process is size. In the nature of the case, engineers want to make their structures as small as possible, in order to get as much on the wafer as possible, and to make it go as fast as possible. The smaller any given structure is, the faster an electron can get from one side to the other. This is the key to very large scale integration (VLSI).

As things get smaller, we run into a number of problems. One is chemical selectivity: the ability to etch one layer and leave the others untouched. Clearly this is important, since there will always be at least three surfaces exposed to the plasma: the target layer, the one above and the one below.

Chris Horwitz and Stefan Boronkay of Labtam with the hollow cathode etcher. Boronkay is touching the lower of the two cathodes. In operation, it slides up towards the compartment above, which is a vacuum chamber. Below is timing and other control equipment.

A second problem is the angle at which the silicon is etched. This is important because if the angles are too steep, it will be impossible to put another layer over the top of it without breaks.

A third problem is that it's difficult to etch both wide and narrow gullies at the same time, especially when dealing with sub-micron dimensions. Because of the density of the gas the ions tend not to penetrate into narrow gullies, which means that small structures are etched more slowly than wide ones.

What Horwitz stumbled across was a method of fixing all these problems. "A plasma is a funny beast," he says. For instance, it turns out that if you connect another plate parallel to the cathode, so making what Horwitz calls a hollow cathode, the result is to create a fireball between the two plates.

This increases the intensity of the plasma to a marked degree. All of a sudden it becomes possible to make the device work at a much lower pressure than before. This means the etching speed increases, as does its uniformity. Because the gas pressure is so much lower and the intensity of the ion bombardment so much higher, etch rates increase dramatically, and no longer depend on the size of the structure. ●

ADVERTISERS' INDEX

GETTING IT RIGHT

The RAAF has started taking delivery of its new fighter, the Hughes F18A Hornet. One result of this arrangement has been the creation of an infrastructure to handle the manufacture and maintenance of one of the most complex fighting machines ever built.

Jon Fairall

THE GOVERNMENT's offset policy is controversial to say the least. Critics say foreign companies ignore it, its supporters say it's the best we can expect. Whatever the truth of the matter, it's nice to be able to report on one project and one place where it does seem to be working.

The idea of the offset policy is that foreign companies doing business with the Australian government should be made to spend a certain portion of their contract in Australia. In the best of all possible worlds this would increase the size of the Australian manufacturing base because foreign companies would sub-contract work to local firms.

One contract where this seems to have worked, at least to some extent, has been the F18A contract. The F18A is the new high technology aircraft being built for the RAAF. The original few planes were made in the US, but the bulk of the 75 on order to the RAAF will be built under licence by the Government Aircraft Factory.

The F18A, like most modern jet fighters travels at about twice the speed of sound. Go above that speed and the physics of engines and jet intakes starts to get very complex, more complex in fact than it's worth. Also, practical aircraft building materials start to run into heat problems because of the friction of air flowing past.

As a result, the speed of modern jet fighters hasn't increased at all since the 1950s. In fact, some of the most significant military aircraft in the world aren't particularly fast. The Hawker Harrier of Falkland Islands fame, for instance, can't even fly faster than the speed of sound.

What distinguishes modern aircraft is their electronic control systems. Without exaggeration, the F18A is a flying electronics store. Everything that opens and shuts is computer-controlled, electronically guided or operated by optical fibres.

For instance, modern fighters are built to be aerodynamically unstable. They need a computer to control their flight surfaces just to achieve level flight. The pilot merely tells the computer where he wants to go.

According to people who have had the experience, flying it is much like being in a video game, if you add in G forces and noise.

The cockpit is modelled on those used in the Hollywood movie "Starwars", with liberal use of computers for tactical information and for selecting information to be displayed to the pilot. In fact, in an environment like a jet fighter where the pilot must react very quickly while under great mental and physical stress the ergonomics of the situation, ie, the relationship between man and machine, becomes critical.

Imagine trying to find the sixth prime number while labouring under 4G with someone trying very hard to kill you and you get some idea of the magnitude of the problem.

Even though speed should not be overstated in a modern jet, they still move very quickly in comparison with ordinary experience. Flying at 800 kph, it takes just four seconds to travel a kilometre. If two aircraft are flying towards each other, a pilot might be able to see his opponent for just one or two seconds.

This was a problem even during WWII. It was solved then by ground controlling radar, and up until fairly recently, that was still the way it was done. Ground control would guide the opponents towards each other. It was only in the final stages that simple radars on the aircraft would acquire the target.

With the advent of modern electronic aircraft, to a large extent the need for ground control has been done away with. The onboard radar can acquire the enemy at a considerable distance. (Just how big a distance is not the type of information freely handed out.) The pilot can then discuss strategy with his computer before engaging the enemy.

In the F18, the radar is central to its effectiveness as a combat aircraft. Building it is one of the tasks assigned to Australian industry. It's not a tiny piece of equipment. It's a grey painted, massive looking box, perhaps two metres long and one high, with a flat radar dish at one end. In situ, it is concealed under the nose cone of the F18A, occupying all the fuselage forward of the cockpit.

Predictably, putting it all together is a complex job. Like all military equipment, it must be built to withstand a considerably higher degree of heat, cold, vibration and mechanical stress that most civilian equipment. Just as importantly, it must be calibrated to extremely high degrees of accuracy to fulfil all its functions.

Philips' calibration lab

The job of ensuring that parameters like voltage, current, capacitance, resistance and frequency are accurate is being undertaken in a specialist laboratory, currently being set up by Philips at its Moorebank plant.

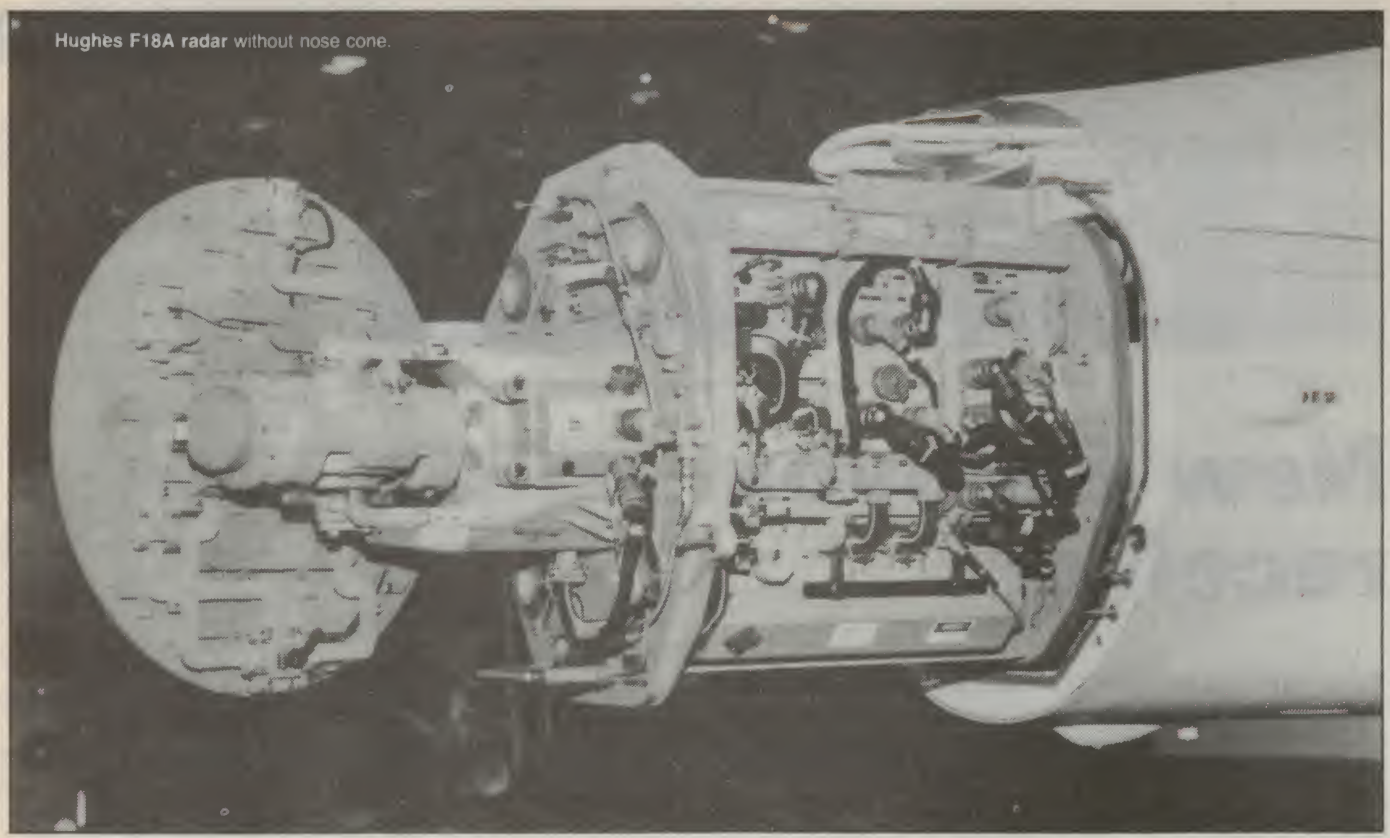
Moorebank is Philips' major manufacturing base in New South Wales. On one side is PABX and other telecommunications manufacturing. On the other side, behind the doors with the one way mirror and God alone knows what other security devices, is the defence area, which currently means the F18A radar to the exclusion of everything else.

The head of the calibration lab is Jacques Degois. "Our raison d'être is to service the F18A contract," he says, "but we hope to be able to provide Australian industry with the best calibration service available within 15 months".

Currently, the lab is working up to its full operating potential. This takes time because each body of instruments needs to be cross checked against other standards over a period of time in order for its behaviour to be assessed.

The most important concept in calibration is the ability to trace the reading. This means that it should be possible to trace the accuracy of any reading taken within the manufacturing plant right back to international standards. To do this a hierarchy is set up, in which one instrument is checked by another instrument. At each step there is an order of magnitude increase in precision.

In a lab like the Philips' set-up, the exact way that is done depends on the value in question, but there is always an unbroken chain from an individual reading back to national or international standards. A dc voltage on a circuit board, for instance, is mea-



Hughes F18A radar without nose cone.

sured on a high accuracy bench voltmeter. The voltmeter is calibrated against a 'transfer standard'. The transfer standard is itself calibrated against a set of test cells, which are kept stationary in a condition of constant temperature and humidity.

The test cells themselves are compared with ones held by the National Measurement Laboratory and Hughes. They are compared by using a portable standard as a go between. Degois claims 2 ppm (part per million) is possible when measuring direct current in this fashion. The actual nitty-gritty of this forms the basis for a unique Measurement Assurance Program of accuracies.

Alternating current voltage can't be measured quite as accurately as dc voltage, because the ac needs to be turned into a dc voltage before it's possible to measure it. What happens is that two voltages are appalied to a thermocouple. One is the ac voltage under test, the other a calibrating dc voltage. When both thermocouples are at exactly the same temperature, dc voltage must be precisely the same as the ac rms voltage. This is a rather nice little test, since it conforms exactly to the definition of an rms voltage.

A great deal of time and energy goes into ensuring that the thermocouples will act as desired. However, they're a major source of inaccuracy in the system. They are also rather frequency dependent. As a result, the lab claims 50 ppm but only for ac below 100 kHz.

Frequency is the parameter that can be measured more accurately than any other in the lab, typically in the order of one part in 10^{11}. Instruments are measured against a cesium standard in the lab. In the normal course of events, tracing a measurement back to some physical constant like the vibration of a cesium atom is good enough.

Inside the Philips lab.

However, for good measure the behaviour of the clock is checked against a number of other cesium clocks. In theory, they all ought to be the same. In practice there is some diversity. However, it's possible to build up a picture over time of whether a particular clock is overly fast or slow, whether it's constant and so on.

The question mark hanging over the calibration laboratory at the moment is whether it will last longer than the F18A radar. According to Degois the future is bright. He argues that as more complex manufacturing is done in this country and more physical values need to be measured sured precisely, there will be a constant demand for the service. ●

New Eurovox receiver

Local car hi-fi designer Eurovox has released a stereo radio/cassette featuring a new generation anti-theft routine which requires two predetermined codes to be entered before the unit will operate if the battery has been disconnected. The code is supplied when the unit is purchased.

The MCC2460E features an ergonomic front panel on which controls are grouped into radio, tape and volume/tone sections on the assumption that this type of layout is easiest to operate. A joystick is provided to set balance and fader at the touch of one knob.

Main display and function indicators are controlled through a photo-electric sensor that automatically adjusts brightness to suit lighting conditions in the vehicle, day or night.

A microprocessor-controlled tape evaluation system (MICTES) will eject any buckled cassette that is loaded. If the cassette jams totally the MICTES will switch to radio operation.

In both AM and FM mode, treble response is gradually reduced when the antenna signal drops below a preset level. While in stereo FM mode left and right channel blending is also gradually performed.

AM frequency coverage extends from 522 to 1629 kHz to include the RPH stations in some capital cities. Channel spacing is 9 kHz for fast manual or seek tuning.

FM channel spacing is 100 kHz to allow all Australian FM stations to be received but still provide fast manual or seek tune. De-emphasis is as per the Australian standard 50 μs.

The unit retails for $1069.

What's new in antennas

We've received news of three antennas from Dressler Electronics Co of West Germany, AOR of Japan and Scalar Industries, Australia.

The Dressler ARA500 antenna is an omni-directional active antenna designed to cover the frequency range 50 to 900 MHz. It will reportedly supply gain of appoximately 18 dB over the standard whip aerial. It has a nominal feed point impedance of 50 ohms.

The design incorporates a two stage amplifier followed by a matching balun network. The antenna is robust, designed to withstand extreme weather conditions and comes with a power supply, interference unit, eight metres of coaxial cable and mounting hardware.

The DA300 model from AOR is a discone type covering 25 MHz to 1.3 GHz, aimed mainly at the scanning market. It consists of 12 radials of varying length with nominal feed point impedance of 50 ohms. It is made of high quality aluminium tubing and stainless steel and comes with mounting bracket and 10 metres of coaxial cable and fittings.

The offerings from Scalar Industries are 9 dB UHF rf control directional Yagi antennas available in six or nine element models in frequency ranges 450-470 MHz, 470-490 MHz and 490-510 MHz. Nominal impedance is 50 ohms. Termination cables are to n type female and power rating is 250 watts. They are made from high grade seamless aluminium tubing.

For more information on the ARA500 and the AOR contact **Emtronics** on **(02)211-0988** and on the Scalar models contact **Scalar** on **(03) 725-9677.**

Pocket computer with 80 Kbytes of RAM

The Sharp PC1600 pocket calculator can be used for a wide variety of applications by estimators, engineers, architects and students. The PC1600 can run enhanced BASIC, which is contained in 96 Kbytes of internal ROM. Software written for the PC1600's predecessor, the PC1500A, is also compatible.

The PC1600's liquid crystal display presents text and symbols on a 4 line x 26 character display. Mini graphs can be shown on the LCD as a 32 x 156 dot display.

The 80 Kbytes of RAM is made up by two 32 Kbyte memory modules and the standard 16K of internal memory. Smaller 16K and 8K memory modules are also available. All of these memory modules are battery backed up and can retain data for five years if stored in the machine, or two years on the shelf.

The PC1600 has an RS232C port and a built-in analogue-to-digital converter. For the more technical user there is a 60-pin bus connector to allow direct access to the central processing unit (CPU). The high speed serial input/output interface is designed for optical communications at 19.2 kbaud.

There are also two peripheral expansion devices, a four colour plotter/printer and a pocket disk drive.

For further information contact **News Management, Suite 5, 1A Broughton Rd, Artarmon, NSW 2064. (02) 411-7799.**

Photocopier with a second colour

The Triumph-Adler 210TC photocopier has an edit feature that makes it possible to select excerpts from an original and delete them, or copy them in a different colour from the surrounding areas without the need to mask and re-copy the original. A second colour is available at the touch of a button.

The TA 210TC also features an easy to understand control panel indicating paper and toner supply, interrupt mode, maintenance required and number of copies. The 'clam shell' design reduces the likelihood of misfeeds and facilitates servicing.

For further information contact **Adler Business Machines, Cnr Lane Cove & Waterloo Rds, North Ryde, NSW 2113. (02) 437-6766.**

Philips and ANZ moving money

The recently opened ANZ Bank's Night & Day Centre in the Melbourne suburb of Balwyn, is reportedly the world's most advanced self-service bank. The new bank branch is equipped with the latest Philips automatic teller machines and other advanced electronic equipment including a laser video from Philips.

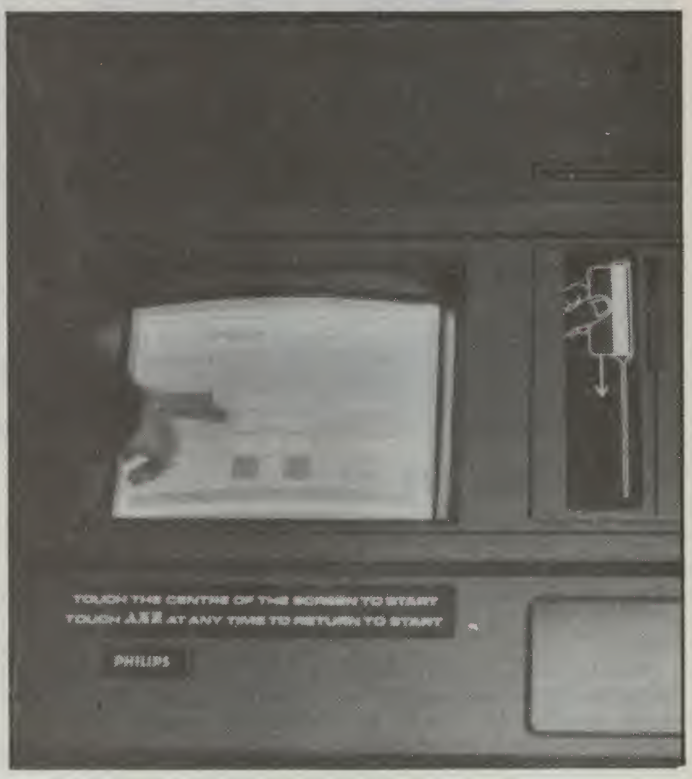
Using their magnetic striped cards, ANZ Bank customers will have access to a wide range of services 24 hours a day, seven days a week in the specially-built bank office. There is even a drive-up automatic teller machine and a drive-in commercial deposit terminal.

Customers of other banks will also be able to enter the centre by using their own magnetic striped cards but they will not have access to all the services available to ANZ customers.

Philips also developed the interactive video disc system which gives customers full details of all the services available from the bank 24 hours a day, seven days a week. With LaserVision, customers will be able to find out about the cost of a loan or see what holiday specials the bank's travel department has.

For customers who are still a little confused about how the centre works — there is a 24 hour hot line telephone service in the centre. Special cameras, also supplied by Philips, keep watch over the centre.

ANZ Bank officials are planning similar centres over the next 18 months. ANZ's General Manager, Retail Banking, Alister Maitland said he was looking forward to hearing from customers who use the new centre.



Back up disks on VCR

TLM Systems has released a VCR back-up for the IBM AT/XT/PC.

The VideoStore VCR back-up board turns a VCR into a data storage and retrieval device.

The device works in conjunction with a software package and the VCR. On a wired remote control VCR the VideoStore will automatically rewind a cassette then read or write the data files identified. If the VCR is manually controlled or uses a wireless remote control, the cassette must be rewound manually and PLAY and RECORD pressed.

The VideoStore boasts a rate of 2 megabytes per minute, meaning an entire 10M hard disk can be backed up or restored in about 5 minutes.

The main features of the VideoStore are dual VCR interface, microprocessor control, high speed LAN channel, error correction facility, multiple copy capability, choice of control levels, user software interface.

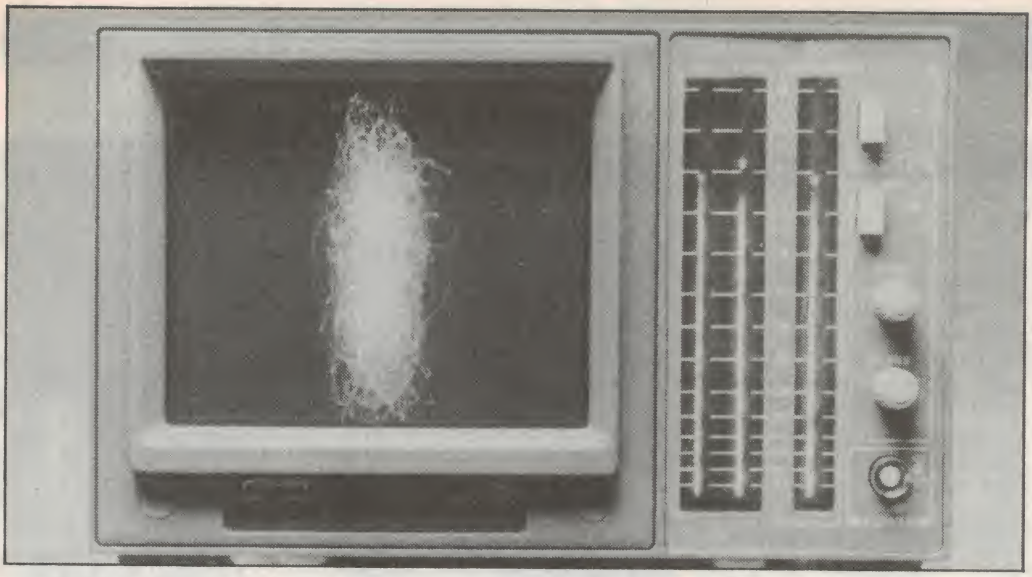
For more information contact **Paris Radio** on **(02)344-9111.**

Custom LCD design guide

Australia's sole manufacturer of liquid crystal displays, Consolidated Technology, has released the "LCD Design Guide". This is intended as both an LCD user's guide and as an introduction to those not familiar with the use and operation of LCDs.

The "LCD Design Guide" explains advantages of custom LCDs over other display technologies. Some of these advantages include choice of exact physical size, use of virtually any character set (including company logos), choice of various display colours and modes, selection of connection medium and the ability to cater for special environments.

Both the LCD design guide and the custom LCDs are available from **Consolidated Technology** which can be contacted via **PO Box 692, Frankston, Vic. 3199. (03) 786-8699.**



Looking at stereo sound

Tektronix has released a stereo audio monitor for audio mixing. The new 760 Audio Monitor is meant to assist in stereo audio mixing.

With its ability to make exact comparisons between the two audio signals, the 760 is designed to detect out-of-phase stereo sound. Distortion can theoretically be eliminated.

The user can monitor and compare the phase of the two audio channels. LED's precisely indicate the amplitude of each audio signal, and the CRT the phase relationship.

Another indicator lets you monitor the sum or difference between audio channels. There's an auxiliary mode too, which allows the operator to monitor another channel such as SAP (second audio program) or a monaural channel.

For further information contact **Tektronix, 80 Waterloo Rd, North Ryde, NSW (02)888-7066.**

Oz dc-ac sine wave inverter

The Power Converter uses new technology to produce a 300 watt peak, 12 Vdc-240 Vac, sine wave inverter.

It has an auto start feature which senses the exact nature of the load. Other features include full current limiting, input reverse polarity protection, battery under voltage cutout, reactive power overload cutout, full voltage regulation, full transient suppression and protection. The Power Converter is claimed to be short circuit proof, has thermal overload cutout and twin power points.

The output wave shape is sinusoidal with less than 5% distortion and efficiency equal to or greater than 82%.

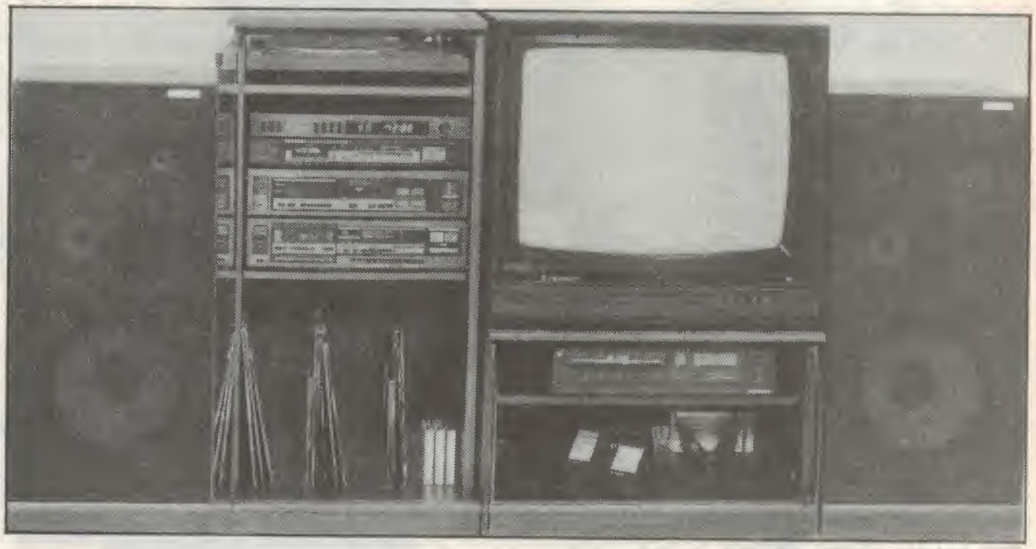
The device is available in a plastic case or in a rugged, water-resistant, higher rating,

Pioneer's new video

Pioneer Australia has entered the VCR and video field with the release of its new hi-fi video recorder and stereo TV. This represents a new direction for the company in line with its total home entertainment philosophy and a broadening of its product base, which until now, has specialised in audio and laser technology.

Pioneer has tried to optimise the VH 600 VCR for audio. Its two rotary audio heads are designed to provide quality hi-fi reproduction. Some of its other features include three position input selection providing flexible recording capability, a four-event with a two-week duration program timer, forward and backward fast picture search and infrared remote control.

Pioneer intends to match the VH 600 with a stereo TV, which will be available in 51 cm and 63 cm screen size. Both models will produce high quality sound. Its built-in dual sound system will enable the selection of stereo or bilingual broadcasts.



Both monitors have been designed with a smoked glass filter to reduce glare for wide angle viewing, 12-position electronic timing to pre-set up to 12 VHF and UHF channels and full function infrared remote control.

"Pioneer's new releases are aimed at the consumer who wants high quality sound. They are not intended for the mass market," says Pioneer Marketing Manager, Doug Bell.

"We do not wish to compete in the general TV and VCR market but Pioneer believes that its reputation for quality sound will give it a specialized market appeal with the discerning viewer," he said.

Pioneer's two new releases give the company a full range in the home area. Recommended retail price for the hi-fi/VCR will be $1599 and the stereo TV will be $1599 for the 63 cm and $1299 for the 51 cm screen size.

metal unit. Both are a similar price to ordinary square wave inverters.

800 W, 1000 W, 1500 W and 3000 W sine wave versions will be available soon.

For further information contact: **Modulite, Factory 6, 42 New St, Ringwood, Vic. (03) 879-2825.**

UK scientists develop optical processor

Scientists at Heriot-Wall University, Scotland, recently announced the development of a prototype optical processor. Described as a primitive optical-finite-state machine, the processor is part of a project to replace electronic currents in transistor circuits with light beams.

The main advantage of optical technology is in speed and in allowing parallel processing. According to Professor Desmond Smith who led the experimental research into the optical processor, "Optical circuits are unique in that they are capable of processing large amounts of information simultaneously. By contrast, the present generation of microchips process individual signals consecutively. This makes optical computers particularly suitable for applications in the field of artificial intelligence, as well as optical image processing".

Professor Smith sees the future of optical circuits in image processing, fibre switching and displays. He and his team have so far progressed from the development of a single-switch device last March to an all-optical digital loop circuit.

The project has been supported by European scientists as well. Frankfurt University, the Fraunhofen Institute in Freiberg, the Max Planck Institute for Quantum Physics, Munich, the Universities of Milan and Pisa, the CNRS Lab at Strasbourg and the Free University in Brussels have all been involved. The program was funded to the tune of $A2.9 by the European Commission.

First phase of the project was aimed at ascertaining scientific evidence for the feasibility of an all-optical processor and at financial assessment of the end product.

BRIEFS

Datacraft catalogue
Datacraft Direct Marketing has just released a new black box catalogue. It contains over 500 problem solving items which have proven popular in the past and more than 50 new lines. Contact Datacraft on (03) 725-1144.

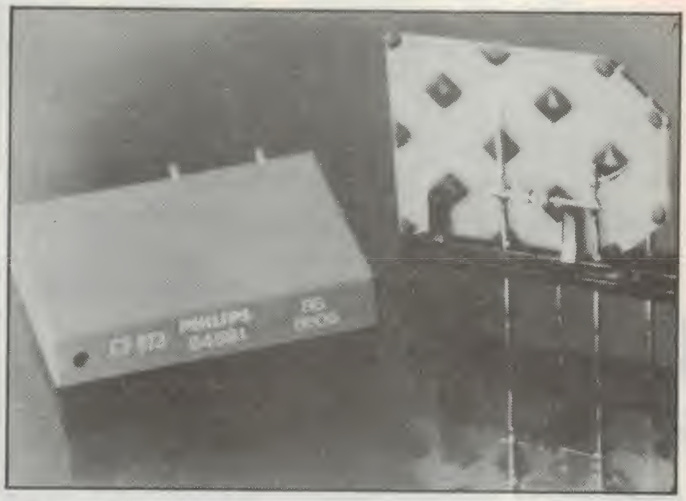
New micro
NEC has released the 708108 microprocessor which is claimed to have an instruction set that is a subset of the 8088. Execution times are claimed to be faster. It's available through the George Brown Group.

Generator
Dindima has released news of the Ballantine 6200A programmable function generator. It runs up to 20 MHz and is fully programmable via the IEEE488 bus.

TI product news
TI has introduced a new member of the TMS320 family intended for microcontroller applications such as servo control, high speed controllers, low-end modems (1200 bps and 2400 bps), audio processors, data encryption, vibration analysis, or similar applications. It's called the TMS32010NL.

Speed enhancement to FIFO
Integrated Device Technology (IDT) recently announced speed enhancements to two CMOS parallel first in first out (FIFO) RAMs, the IDT7202 and IDT7201. The new time represents a 40% increase in speed over previous parts.

SIPMOS signal transistors
To meet the growing importance of automatic surface mounting, Siemens is expanding its range of transistors in SOT-23 housing. New arrivals are the BSS84, BSS131, and the BSS 138.



Comb filter
Philips has introduced a comb filter for use on PAL video recorders. It's called the CRF873, and consists of a very thin slab of glass with a zero temperature coefficient mounted in a shock-proof housing.

CCD camera
AWA is distributing an ultra miniature CCD camera from Pulnix designed primarily for surveillance. Dimensions are 36 by 32 by 127 mm. Power required is only one watt at 12 V.

Motion detectors
Benmar International has released the GOS2578 pulsed motion detector from Alpha Industries. Frequency range is 9.47-10.7 GHz, 1% duty cycle with 20 μs typical pulse width.

Chip caps
Penn Central is selling Sprague Electric tantalum chip caps that conform to EIA standards. Values are between 0.1μ and 100μF.

HAKKO ACE DESOLDERING STATION

Have you got headaches from pulling big mother chips out from a double or multi-layer board?

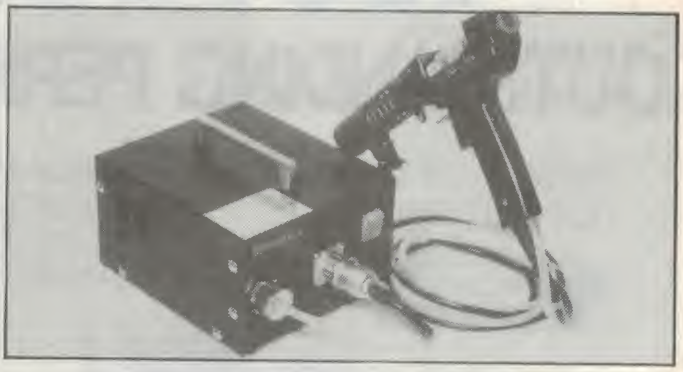
Desoldering bits are frustrating when the chips to be pulled out are of different sizes — one has to keep changing the bit size. With high density (ULSI, VLSI) chips, pins are arranged in a matrix form, and desoldering bits won't work with them. Fortunately, Japanese company, Hakko, has provided a brilliant solution with its Hotas desoldering station.

Hotas is a unique sensorless, zero-cross switching, on/off temperature control system developed to fit into its 40 W desoldering stations. The temperature is accurately controlled between 300°to 400° (Celsius). Of the two models available, the 481 has the basic features and the 483 has an added user heat selection facility.

The compact gun-type desoldering irons weigh only at 230 g, featuring one finger trigger with powerful suction up to 600 mm Hg. The sucking neck is narrow (13 mm diameter) and long (50 mm) to reach spots on today's high density pc boards. Inside the neck is a small tube for the melted solder to be sucked up from the board to the filter.

The length of the tube is surrounded by a high quality ceramic heating element to keep the solder in a completely melted state until it lands on the filter. Fitted to the end of the neck is an easily changeable nozzle. A variety of nozzles are available to match any work requirement and permitting greater thermal transmission efficiency.

The other end of the neck is joined to a heat-proof transparent glass filter pipe. The filter inside the glass pipe is made up of some steel wool in the front to block the sucked solder and a fairly thick layer of cotton behind the steel wool to absorb the flux. With the glass pipe, the accumulation of solder on the steel wool can be easily checked. To replace the filter, one simply pulls a knob at the back of the gun to remove the glass pipe.



This unit is very useful and efficient all round. The only improvement I could suggest is the incorporation of a user selectable suction power option with a maximum sucking power greater than 600 mm Hg. The sucking power as it is is fine when the filter is clean, but as the solder starts to accumulate, the suction force reduces until the filter is replaced. Although the replacement job is easy, it would be nice to be able to re-adjust the suction power and avoid replacing the filter so frequently.

— S.K. Hui

Colour hardcopy from screen to printer

Electrical Equipment is selling the Graftel VP 200 video processor, designed for printing colour hardcopy from graphics displays. It accepts RGB video input and is compatible with virtually all computer systems. It has a palette of eight or 64 colours with multiple shades. Resolution is 1280 by 1024 pixels. Electrical Equipment is at Unit C, 8 Lyon Park Rd, North Ryde, NSW 2113.

Extended distance data cables

The Belden 9680 and 8102 families of paired overall shielded extended distance data cables are now available from Acme Electronics in Australia.

The 9680 family has a capacitance of 50.8 pF per metre and a 6 dbv length limit of 640 metres. The 8102 family has a capacitance of 41 pF per metre and a 6 dbv length limit of 640 metres. Acme Electronics is at 205 Middleborough Rd, Box Hill, Vic 3128.

Solid state, microwave power amps

Three new GaAs FET, microwave, power amplifiers, have just been released by the Central Microwave Company, adding to the excellent range of microwave power amplifiers currently available. The CMA 53750 covers 14 to 14.5 GHz, the CMA 44450 covers 8.5 to 9.6 GHz and the CMA34460 5.9 to 6.4 GHz. They are represented in Australia by Benmar International, (02) 233 7934.

Teknis pad

An attenuator pad packaged as a hybrid has been developed by Teknis in Adelaide. The TE-2000 is a 600 ohm balanced pad with seven fixed selectable pads between 0.5 dB and 16. dB.

CMOS 16-bit microcontroller

National has apparently leapfrogged the rest of the industry as from last March by producing the CMOS 16-bit HPC16040. A complete microcomputer on a single chip, the HPC16040 is the first release in the company's new HPC (high performance microcontroller) family.

Colour CCD surveillance camera

Australia's Cameronics Technology will take on the giants of the international electronics industry when it releases an advanced colour CCD surveillance camera on world markets later this year.

The highly-sophisticated CCD (charged coupled device) camera uses new technology, which the company claims to be far ahead of any competitor's products. A prototype has been thoroughly tested and will go into production within two months.

The camera's main advantages over competitors' products is that it has ultra high resolution and that it shows colour under extremely low light.

Cameronics' CCD can also be used for robotics systems and with underwater recovery vehicles.

As a seeing eye, it will allow a robot to select parts in a production line by their colour or identify objects underwater by colour.

The Cameronics CCD uses a unique imported computer microchip, but the camera was developed by the company's research and development department in Perth.

For further information contact **Cameronics Technology, 58 Clavering Rd, Bayswater, Western Australia 6053. (09)272-1000.**

Perth circuit testing

Circuit Technology Holdings has established Western Australia's first independent centre for testing electronic circuit boards at Willetton, Perth.

This follows an agreement with the WA Technology Development Authority to licence the Circuit Technology group to provide a testing service based on a Technos WPV 68 machine from Olivetti Australia.

The equipment will check unloaded boards for broken circuits and interconnections that shouldn't exist and pinpoint where the fault occurs.

Circuit Technology is planning to increase the test centre's capabilities by installing equipment to handle loaded boards, that is, boards with fitted or bonded surface mounted devices, such as microchips.

For more information contact **Circuit Technology Holdings** on **(09)457-6388,** or **Mick McGowan (02)977-6513.**

New Pioneer releases

Pioneer has released a new high power car radio/cassette for the up-market buyer, as well as a good quality 10 cm car front speaker system.

The KEH 5020 features auto reverse for uninterrupted playback, electronic seek tuning, locking fast forward and reverse and the usual controls for volume, etc. The new system will belt out sound at 20 watt music output power.

Pioneer's 2-way, 30 watt speaker, the TS 1080, incorporates a specially designed hydro resistant 100 mm HR cone woofer or 42 mm cone tweeter encased in new styling grilles made of heat proof resin.

Pioneer suggests the speakers will suitably team with the 16 cm product in a four speaker system. They've been designed to meet the new high demand placed on speakers with the advent of the compact disc and with higher output amplifiers and graphic equalizers. The speakers have frequency response of 50 Hz to 21 kHz with sensitivity of 91 dB.

Mobile sat dishes access to Aussat

Network Technologies claims to have designed and manufactured the first mobile 3.7 metre, commercial quality, satellite dish for Australia. These dishes enable professional quality audio and video communications to be available at any location anywhere in Australia.

Network Technologies says it will transport the mobile satellite dishes to any site in Australia which is accessible by vehicle, be it a city hotel, a country office or a private home. The dishes can be towed by any vehicle capable of towing a 4.5 metre boat and can be commissioned for use in a few minutes. The dishes can therefore be located in remote places and allow participation in satellite videoconferences, for example.

The dishes can receive sound and video signals via any of the Aussat transponders. They can also work in conjunction with any of the video transmission standards of the various broadcasters in Australia.

The Australian-made dishes can be hired on a short or long-term basis or purchased from **Network Technologies, 3rd Floor, 77 Berry Street, North Sydney, NSW 2060. (02) 957-3137.**

80K RAM IN HAND!

The new Sharp PC-1600 pocket computer is one of the most powerful pocket computers available, offering more power in your hand than many desk-top computers. The Sharp PC-1600 is a first cousin of the acclaimed Sharp PC-1500/A - the new model is upwardly compatible and will run the wide range of software developed for the PC-1500/A.

Power up to 80K RAM

Equipped with a standard 16Kb RAM, the PC-1600 easily expands to 80Kb by adding two 32Kb Memory Modules into the memory expansion slots in the back of the unit.

With its full memory complement the PC-1600 comfortably matches the performance of many lap and desk-top PC's.

Quotations, engineering calculations, estimates, billing, price lists and inventory enquiries, portable data collection and data analysis can all be done on the spot.

Business people, engineers, researchers and sales people will find the PC-1600's ability to help them "think on their feet" and then store calculations and data for later retrieval, a valuable time-saving tool.

BASIC with room to use it

The PC-1600 has a 96Kb ROM containing the popular BASIC language. With extra Memory Modules you'll have 80k of RAM... enough to run quite sophisticated programs without having to return to your office.

Interfaces with other business equipment

Sharp PC-1600 talks direct to other personal computers for data and program file exchange. You can also hook it up to a printer, an acoustic coupler or modem, an optical fibre cable, a tape-recorder, a disk drive and even a bar code reader (available soon).

It'll even wake you up and make the coffee!

The PC-1600's built-in timer acts as a calendar, watch and an alarm clock. Connected to the built-in communications port, you can use the PC-1600's timer to control external devices, such as electronic scales, lab equipment, measuring devices, even office lighting and the coffee percolator.

Plug in a compact printer and disk drive

This is where the Sharp PC-1600 really comes into its own. We have a special Colour Plotter Printer and Mini Disk Drive you can attach to the PC-1600.

The whole unit is lap portable, battery operated and occupies space a bit bigger than an A4 page. So it fits in a briefcase with plenty of room to spare.

Add the Plotter Printer and you can print out in text, or present your results with highly sophisticated graphics. All this on the spot, on A4 paper in four colours.

And with the disk drive you can store 128Kb on each 2.5" floppy disk.

There are no untidy wires; the computer, printer and disk drive slot together into one sturdy, compact unit.

Before you decide on a pocket computer, look at the Sharp PC-1600. Because it can perform so many tasks and expand so many ways it may be the only computer you'll need for a very long time to come.

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ETI READER SERVICE 27

RADIO SPREADS THE WORD

Once the listener can pick up signals and identify stations, a whole new world of programming awaits him. But not the soapies and humdrum of the other popular broadcast bands. Shortwave broadcasts are nothing if not didactic.

A. Cushen

From the past. The original studio building of Trans World Radio, Monte Carlo in 1956.

MOST SHORTWAVE broadcasting stations are established by authorities with a message to spread, whether government propaganda or service information. One broadcaster very active on shortwave is the gospel station and the listener is likely to find no shortage of religious faiths disseminated.

The modern missionary is behind the microphone and talking to millions of radio listeners. Mass from the Vatican, Billy Graham from the Philippines, Bahi from Ecuador, the Holy Koran Reading from Saudi Arabia, Hebrew Services from Israel, and countless other religious services and denominations are available on the high frequency bands. Radio has become the high point in missionary work; it is possible to reach millions of listeners world wide.

It was in 1931 that two religious organisations began missionary broadcasting. The Vatican commenced its first broadcast in February and later that year, on Christmas Day, HCJB Quito, Ecuador made its pioneer broadcast. It is interesting to note that neither of these stations have extended their working by the use of relay stations, but have preferred to increase the power of their transmitters to reach the world from the one transmitting site.

Vatican radio

At 4.30 pm on 12 February 1931 Guglielmo Marconi, who designed and built Vatican Radio on the most advanced scientific and technical principles, invited the Holy Father to use its microphones to speak to the world. Pope Pius XI with great solemnity, delivered his message to all men. It was the first time that the voice of the Pope could be heard throughout the world.

Transmissions were expanded and during World War II the Vatican Radio performed outstanding service in re-uniting families and friends. During those six years, over one million messages were handled by Vatican Radio, and as it was located on neutral territory, the station was able to more easily perform this service.

After the war the transmitting power was extended to five 100 kW units. When the writer visited the transmitting site at Santa Maria di Galeria, outside Rome, he noted that the transmitters bore the name plate of the donors: one was from Australia and New Zealand.

Since then a new 500 kW transmitter has been added, a log periodic aerial and the number of language broadcasts extended from 16 to 35, broadcasting a total of 30 hours per day.

Transmissions to Australia are 2205-2225 UTC on 6015, 9615 and 11830 kHz; another broadcast 0200-0215 UTC on 7125, 9650 and 11865 kHz, is also in English. A multi-language programme called "Four Voices" is also heard on shortwave though it is of primary interest to visitors to the Vatican as it broadcasts tourist information. It is heard weekdays at 0600 UTC on 6250, 9645 and 11740 kHz.

HCJB, Quito Ecuador

Using the slogan, "Heralding Christ Jesus' Blessings," which makes up the call sign acronym, this well known gospel station was founded on Christmas Day 1931. It broadcast with low power from a sheep shed and is regarded as the pioneer of missionary radio.

The station signed a contract with the Ecuadorian Government and has always been looked on as the official voice of that government in time of crisis and disaster; it has offered its transmitters when the need has arisen.

HCJB has progressed to offer a multi-language service with programmes scheduled to all parts of the world. Programme services now cover not only international languages, but those directed to the local population in the Andes area. HCJB has daily programmes to Australia, 0700-1130 UTC on 6130, 9745 and 11925 kHz, and operates around the clock.

The station is also involved in educational, medical and missionary work within Ecuador. Its pioneering spirit is evident in the creation of its own hydro plant so that energy is available for the many transmitters, including one of 500 kW. With its transmission point high in the Andes Mountains, close to the equator, it is ideally situated for world wide reception.

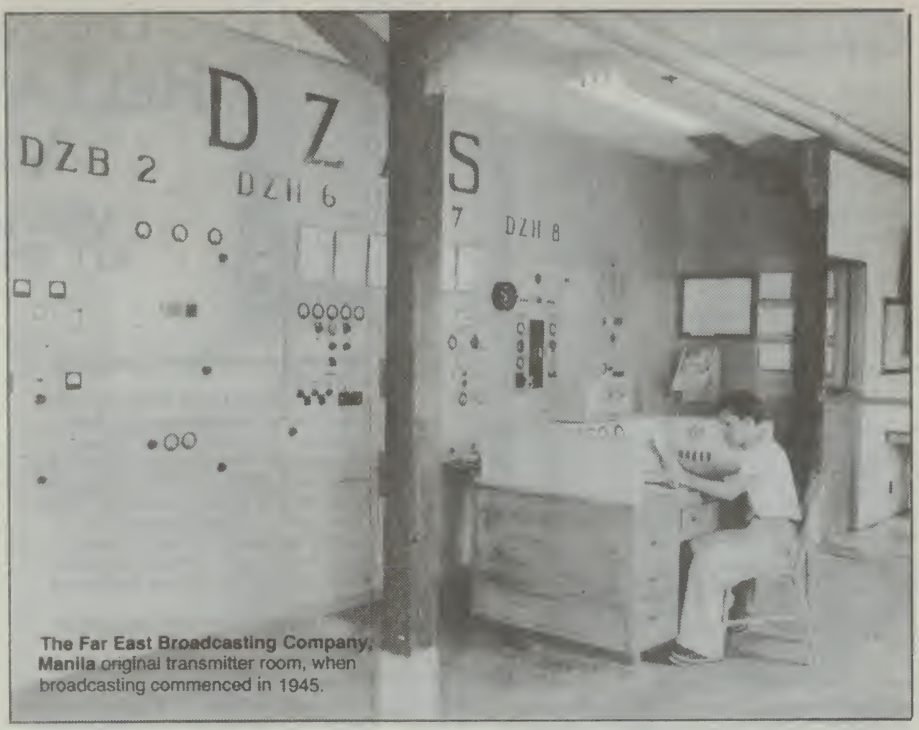
FEBC & FEBA

The Far East Broadcasting Company was founded in Manila in 1945, with the original slogan of "the call of the Orient". Now it identifies itself as "FEBC Radio International, the sound alternative".

FEBC has concentrated its broadcasts on the Pacific Basin and now has programmes in 60 languages and dialects. After its establishment in the Philippines, FEBC opened stations in Okinawa which were later closed when Okinawa was handed back to Japan. A powerful mediumwave station was then established in Cheju off the coast of South Korea, followed by the purchase of KGEI, San Francisco.

KGEI was established in 1939 at the World Fair. It was later purchased by FEBC to serve Latin America and Asia. The latest station to be operated by FEBC is KFBS Saipan, which beams programmes to Asia and has recently taken over the Japanese broadcasts, formerly carried on KGEI.

FEBC broadcasts around the clock in



The Far East Broadcasting Company, Manila original transmitter room, when broadcasting commenced in 1945.

many Asian languages, and its English transmission to Australia 0830-0930 UTC can be found on 15350 and/or 11850/11890 kHz. As well as many shortwave transmitters, FEBC operates a network of mediumwave stations throughout the Philippines ranging in power up to 250 kW with the key station, DZAS Manila on 702 kHz.

The Far East Broadcasting Association is a British based gospel group and works in conjunction with FEBC Manila; the broadcasts of FEBA are from the Seychelles in the Indian Ocean, off the coast of Africa. Broadcasting commenced in 1970. The transmitting towers are unique as they are anchored on a coral reef which gives the station a tremendous lift in signal strength throughout Asia and Africa. It is one of the strongest signals from East Africa in Australia.

Broadcasts are directed to Asia, the Middle East and Africa in 25 languages including broadcasts in English at 0712-0845 UTC Sundays on 15120 and 17780 kHz, while a second transmission is 1458-1608 UTC on 11760 and 15325 kHz.

Trans World Radio

Described as the most powerful complex in the world of gospel radio stations, Trans World Radio now broadcasts from its key station in Monaco as well as relay bases in Swaziland, Cyprus, Sri Lanka, Guam and Bonaire.

The writer first heard its broadcasts when it opened in the international zone of Tangier in 1954 as WTAN. Its power then was only 2500 W. The station then moved to Monte Carlo and today its world wide network uses 21 transmitters on shortwave.

Listeners in the Pacific are aware of Trans World Radio KTWR in Agana, Guam, which has a special antenna beamed to Australia, used in the transmission on 11735 kHz. On Saturday at 0830 UTC it features "DX Listeners Log".

The Bonaire transmitter has a powerful mediumwave signal on 800 kHz, PGB; its shortwave services are beamed to North, Central and South America. In Sri Lanka, a high powered mediumwave station, carries programmes to Asia, while the Swaziland complex covers Africa. The transmitters on Cyprus and Malta both have a power of 600 kW on mediumwave and broadcast time is leased from the controlling authority.

ELWA

Broadcasting from Monrovia, Liberia, ELWA was the first missionary radio in Africa and along with ETLF in Addis Ababa, Ethiopia, it was a pioneer in this field; the latter station was taken over by the Ethiopian Government some years ago.

ELWA began in 1952 operated by the Sudan Interior Mission. Its coverage today includes all of Africa, using six transmitters and broadcasting in 42 languages.

Broadcasts are frequently heard in Australia at 0600 UTC on 4765 kHz and at 0700 on 11830 kHz. The station has a wide variety of programmes and relays of the BBC and VOA news are popular features.

Radio Veritas

It was on 11 April 1969 that Radio Veritas commenced broadcasting. The writer can recall hearing the first transmissions in the 13 metre band, prior to the official opening when it relayed mediumwave station DZST.

Today Radio Veritas has one 50 kW mediumwave and one 50 kW and two 100 kW shortwave transmitters carrying its service to Asia in a multitude of languages. Its friendly voice is reflected in the tremendous mail received from the Asian area. This Catholic gospel station has links with Radio Vatican and Radio Renascencian Portugal.

The programme schedule is beamed exclusively to Asia, but English transmissions are often heard in Australia 0200-0225 UTC on 15195 kHz and 1500-1530 UTC on 9595 kHz. The studios are in Manila, and the address is PO Box 939, Manila, Philippines.

AWR stations

Adventist World Radio is rapidly expanding its radio network from its original transmission carried over the transmitters of Trans Europe in Portugal. The AWR Asia programmes were a familiar part of broadcasting from Sri Lanka, and now a new station is under construction on Guam. AWR broadcasts, via its low powered transmitter, have been widely reported in Forli, Italy. In Latin America the long established station in Guatemala is to be assisted in its programming to the Caribbean and Latin America by a new unit in Costa Rica.

The first broadcast on behalf of the Seventh Day Adventist denomination in Southern Asia, took place on 30 April 1950. It was over Emisora Goa. When this station closed, transmissions were transferred to the Sri Lanka Broadcasting Corporation.

The first European broadcast took place in 1971. The Trans Europe site at Sines, Portugal, was used to carry the broadcast on a 250 kW transmitter. Transmissions were later extended to include ones in eastern European languages, and a transmitter at Cyclops, Malta was added for this purpose in 1975.

In Central America the Guatemalan ▶

Adrian Peterson, compere of Radio Monitors International which recently ended 11 years of broadcasting from the Sri Lanka Broadcasting Corporation.

operation is low powered on medium and shortwave. In Costa Rica AWR has purchased an existing station and will use the slogan Radio Lira International on the frequencies of 11870 and 15210 kHz.

United States

The postion in the United States is one of rapid growth after many years in which only three gospel stations operated on shortwave; newcomers on the air or under construction, total eight as we go to press. Already in operation are WRNO, KCBI, WMLK, KNLS, while under construction are KVOH, NDXE, KSPI and World Harvest Radio. The Christian Science Monitor is also proposing a shortwave service; it joins the long established KGEI San Francisco, WINB Red Lion PA, and the most extensive of all, WYFR Family Radio.

In 1974 Family Radio began shortwave broadcasts, and today from its transmitting site at Okeechobee, Florida, transmissions originate which cover Europe, North, Central and South America. The transmitters include eight 100 kW and two 250 kW units. WYFR broadcasts around the clock in many languages and English is received 0600-0800 UTC on 7400 kHz.

KNLS Anchor Point Alaska is well received in its English transmission broadcast 0800-0900 UTC on 11860 and 1630-1930 on 11965 kHz.

This survey of gospel radio stations covers only the major broadcasts; there are countless low powered stations on shortwave operating from such countries as Bolivia, Honduras, El Salvador and Haiti. As well as this, many denominations lease time on international stations. ●

MINIMART

WANTED: SYSGEN-M and/or documentation for MUON (ADDS) operating system. Please reverse charges, (02)660-3969, Rod, 189 Bridge Rd, Glebe, NSW 2037.

WANTED: CIRCUIT LAYOUT for Fox Apple computer Ver 4.6, also Motorola D2 kits or expansion modules. F. Horvat. (08) 388-5430, PO Box 359, Glenside, SA 5065.

FOR SALE: KIND HOME wanted for 1950s radiogram. Repair or install your hi-fi. Excellent cabinet, $29. Labcraft belt drive turntable $17. (02) 498-7805.

FOR SALE: OLIVETTI TE300 teleprinter tabletop version has wiring fault $100; information electronics early model video terminal has extended keyboard, serial and printer ports plus circuits $150. J. Wicks (08)547-7787.

FOR SALE: RADIO HISTORY. A collection of 80 pre-1950 radio and radar valves and cathode ray tubes. Many not well known and very rare. Most are unused. $350. Also a Bendix TA12B aircraft transmitter (WWII), any serious offers on this? N. Allen, 7 Lowry Heights, St Helens, Tas. (003)76-1773.

FOR SALE: SCANNER listing of Australian civil/military VHF/UHF aeronautical frequencies. Approx 500 sorted freq/location/service $5. D. Vale, VK3CDI QTHR, PO Box 2395, Mildura, Vic 3500.

FOR SALE: ROTEL 1212 stereo amplifier. 70Wrms/channel each with own power supply. Comprehensive switching facilities include pre out, main in, $150. Bruce Donaldson (079)22-1382.

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+12 V 1 amp
–12 V 1 amp

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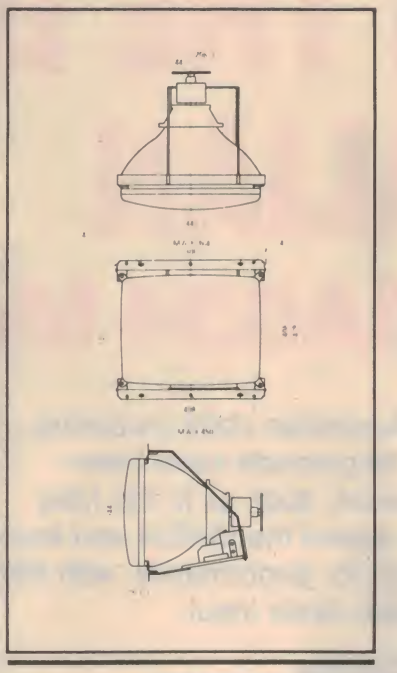
20" MONITOR (Colour) MS7 - 20



CRT	19"V 90° deflection 819.7R inline TV grade
Input Signals	Separate
Data Signal	2.5 – 5Vp-p (positive)
Sync. Signal	0.5 – 5Vp-p H/V Composite negative
Center Resolution	320TV lines
Display Area	365mm (H), 274mm (V)
Display Time	42.5*us* (H), 13.5ms (V)
Blanking Time	14*us* (H), 1ms (V)
Scanning Frequency	15.75KHz (H), 60Hz (V)
Video Bandwidth	6MHz
Input Connector	6pin connector (JST)
Power Source	100VAC, 50/60Hz
Power Consumption	60W
CRT Tilt	————
Weight	17.5kg
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BUYING THE BEST AUSTRALIAN

—Model MA534 Murray amp

Murray Amplifiers Pty Ltd is an Australian outfit producing professional quality audio gear. Its products have been chosen for many a celebrated venue, such as in the New Parliament House. Louis Challis tested the MA534 and found it stood up well to Murray's claims for performance, with the added attribute of a CD compatible direct input.

Louis Challis

TWO OF AUSTRALIA's best known names in the amplifier business are Bill Cherry and Cyril Murray. Although Bill Cherry is famous for his 'nested feedback loop' design, he appears to have lost interest in amplifiers in the last few years. By contrast, Cyril Murray has continued to develop state of the art amplifiers based on large scale integrated and hybrid circuit modules, and conventional field effect transistors.

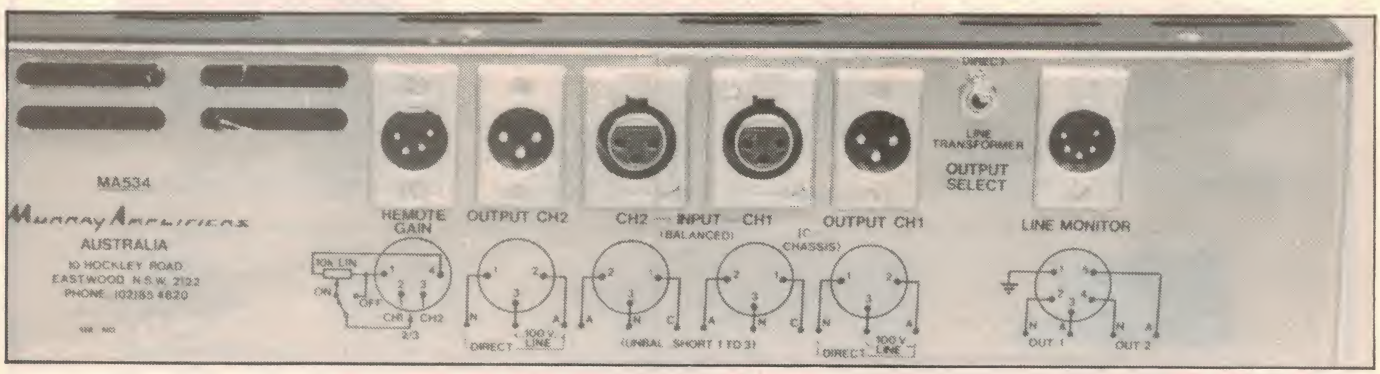
There have been many thousands of Murray amplifiers constructed for private and commercial use in Australia. The earliest privately constructed units hark back to the mid 50s and were based on Cyril Murray's now famous 'single ended push-pull' design. That was probably the finest valve amplifier available in the world at that time. In 1984 Murray amplifiers were used at the Commonwealth Games at Brisbane, with notable success in driving the loudspeaker system (which was my design responsibility). More recently they have been specified as the main work-horse amplifier for high quality amplification, sound monitoring and general public address applications in the New Parliament House, Canberra.

The amplifier that Murray's submitted for review is one of those specifically developed for the New Parliament House project. It incorporates many innovative concepts which make it suitable for a wide range of both consumer and commercial applications.

Design and appearance

The frontal appearance of this amplifier, although unquestionably neat and to an engineer possibly attractive, is typical of the unassuming and conservative approach of its designer. The front panel is designed for conventional 19" (482 mm) rack mounting with a pair of neat chrome-plated tubular steel handles at each end of the front panel.

The brushed satin aluminium front panel



MURRAY AMPLIFIERS PTY LTD
MODEL MA534 POWER AMPLIFIER

Dimensions: 482 mm x 89 mm x 310 mm
Weight: 10.2 kg
Manufacturer: Murray Amplifiers Pty Ltd, 3a Railway Rd., Meadowbank, NSW 2114. (02) 807-2077. The amplifer may be auditioned at Arrow Electronics, 342 Kent St, Sydney, NSW 2000. (02) 29-8580.
Price on application

features simple, neat, black, silk-screened lettering with a large red power switch at the right hand end of the panel. Near the centre of the panel are two recessed gain adjusting potentiometers for each of the two channels, which are controlled by a REMOTE/LOCAL switch.

The gain controls are flanked by four LEDs centrally positioned at the lower edge of the front panel. A further two are provided for voltage indication. These are the only user accessible controls provided, with the exception of a selector switch on the rear panel.

The primary pairs of green and red LEDs indicate alignment level and peak overload conditions respectively. The REMOTE/LOCAL switch allows you to change the amplification control to a remote potentiometer, about which I will have more to say later. It provides a flexibility which has both high fidelity and many commercial applications.

The rear panel incorporates a fused 240 V IEC mains socket; four pairs of male and female XLR three-pin sockets for balanced inputs and balanced outputs; a four-pin Cannon male socket for remote gain control; and a five-pin male Cannon socket for line monitoring of both channels. The only other control on the rear panel is an output selector switch. It wires the output to either the direct low-impedance output from the amplifier for directly connecting a pair of 4 or 8 ohm speaker loads, or alternatively, to switch in the internal 100 V line transformer outputs to meet the requirements of multiple speakers when connected to extended length cabling.

The base of the amplifier features a solidly constructed 2 mm thick aluminium chassis. Either side of the base are deeply finned aluminium heatsinks with field effect power transistors mounted on normal mica-washers and covered by plastic covers. The heatsink configuration has been carefully designed for minimal thermal resistance with an innovative and somewhat unusual solid external chassis providing external mechanical protection.

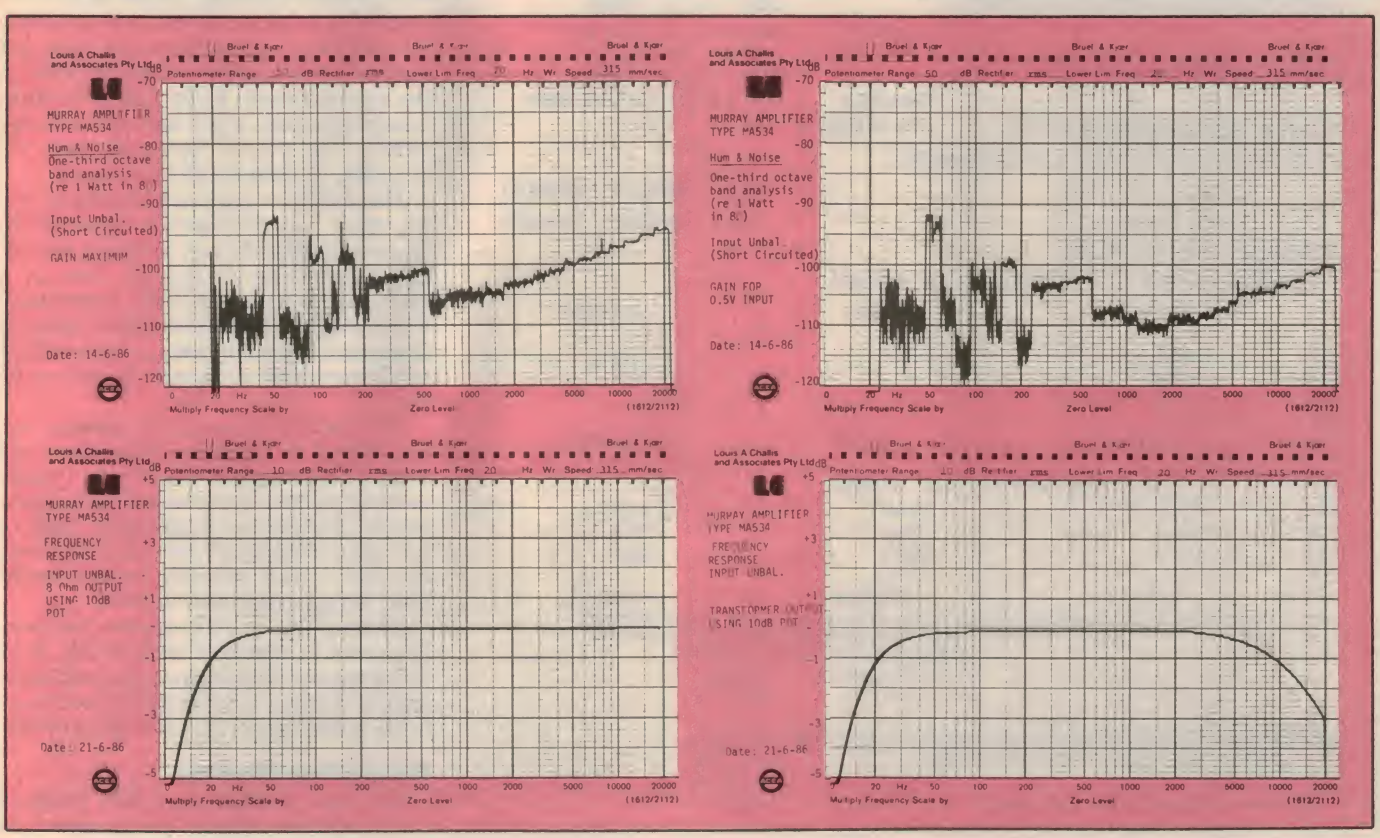
The field effect power output transistors have been selected for a couple of reasons. The first of these is that they are primarily 'an even harmonic' device which means that when used in push-pull circuitry they provide optimum harmonic reduction. (By contrast, the conventional bipolar transistors have a tendency to generate higher order harmonics which are not effectively cancelled when used in push-pull circuitry.)

The second attribute of the field effect transistors is that they provide superior thermal stability and do not suffer secondary voltage breakdowns as do the bipolar power transistors.

The top cover of the amplifier case is slotted over the heatsink area, as well as over the rear section of the amplifier, to ensure adequate thermal dissipation. The bottom of the chassis does not extend to the region below the heatsinks with which it is directly connected. The amplifier does not incorporate a cooling fan, but because of the configuration chosen, fitting of a cooling fan at the top or bottom of the rack would obviously enhance the thermal efficiency of the system.

The inside of the amplifier is contemporary in its quality of construction. The first thing that catches your eye is the solid chassis which has obviously been designed to withstand the rigours of commercial usage, quite apart from any future needs of servicing.

The next things to catch my eye were the two toroidal 100 volt line output transformers bolted snuggly to the base of the chassis on one side of the unit. At the other end of the chassis is the toroidal 240 volt to low voltage power supply transformer, which is neatly boxed and screened, and balances the overall weight distribution. These transformers, although more expensive than the conventional 'E-core' transformers that ▶



MEASURED PERFORMANCE OF: MURRAY AMPLIFIER TYPE MA 534

SERIAL NO: 46

100V OUTPUT VIA TRANSFORMER

FREQUENCY RESPONSE (-3dB re 1 watt):

Input to Aux = 0.5V	No 1	Left	14.4 Hz	to	18.0kHz
	No 2		15.1 Hz	to	19.8kHz

SENSITIVITY (for 1 watt in 100 Ohms):

	Left	Right
Auxiliary	190 mV	182 mV

HARMONIC DISTORTION:

AT RATED POWER OF 1.0 WATTS INTO 100 OHMS

	100 Hz	1 kHz	6.3 kHz
2nd	102.6	100.6	93.3
3rd	96.7	103.3	98.6
4th	117.9		
5th			
T.H.D.	0.0016%	0.0011%	0.0025

AT RATED POWER OF 100 WATTS INTO 100 OHMS

2nd	70.9	90.9	94.2
3rd	74.5	91.2	101.1
4th	78.2	-	109.0
5th	82.5	108.4	
T.H.D.	0.053%	0.004%	0.0022%

IEC HIGH FREQUENCY TOTAL DIFFERENCE FREQUENCY DISTORTION

8 kHz and 11.95 kHz mixed 1.1

At rated power	0.0036%
At 1 watt	0.0021%

8 Ohms OUTPUT

UNBALANCED INPUT LOCAL GAIN CONTROL

FREQUENCY RESPONSE (-3dB re 1 watt):

Tone Controls Defeated

Input to Aux = 0.5V	CH 1	140 Hz	to	55.0kHz
	CH 2	140 Hz	to	52.5kHz

SENSITIVITY (for 1 watt in 8 Ohms):

	CH 1	CH 2
Auxiliary	166 mV	168 mV

INPUT IMPEDANCE (@ 1kHz):

	Left	Right
Auxiliary	11.0 k ohms	11.0 k ohms

OUTPUT IMPEDANCE (@ 1kHz): 235 milliohms

NOISE & HUM LEVELS (re 1 watt in 8 ohms):

Input 0.5 V	94	dB(Lin)	89 dB(A)
Input 168 mV	89.5	dB(Lin)	85 dB(A)

HARMONIC DISTORTION:

AT RATED POWER OF 1.0 WATTS INTO 8 OHMS

	100 Hz	1 kHz	6.3 kHz
2nd	98.8	100.7	91.9
3rd	110.2	-	97.8
4th	117.2	-	-
5th	116.1	-	-
T.H.D.	0.0013%	0.0009%	0.0028%

AT RATED POWER OF 100 WATTS INTO 8 OHMS

2nd	102.5	103.8	91.8
3rd	96.3	99.6	92.9
4th	120.1	120.5	104.5
5th	117.0	-	-
T.H.D.	0.0017%	0.0012%	0.0035%

IEC HIGH FREQUENCY TOTAL DIFFERENCE FREQUENCY DISTORTION

8 kHz and 11.95 kHz mixed 1.1

At rated power	0.003%
At 1 watt	0.0021%

MAXIMUM OUTPUT POWER AT CLIPPING POINT (IHF-A-202):

(20 mS burst repeated at 500 mS intervals) = 100 V p-p

= 156 watts

∴ Dynamic Headroom (re 100 watts) = 1.9 dB

might have been used, ensure that there is minimal flux leakage and inductive mains pick-up within the confines of the unit.

At the base centre of the chassis is a beautifully constructed, fully-protected fibreglass motherboard on which all the internal protective fuses are located, and which incorporates the Eurocard socket assemblies into which the two amplifier boards are plug-mounted. These small preamplifier boards are the heart of the unit and are fed by a separate regulated supply from that used for the output stage. These particular circuit boards incorporate all the innovative 'loving care and design attention' that Cyril Murray could bestow upon them. They are undoubtedly examples of the most advanced designs currently available in the world.

If these amplifiers are the heart of the unit, then their soul is within the two pairs of large-scale hybrid circuits fabricated to Murray Amplifiers' unique design by Philips at Hendon in South Australia. One of the basic concepts that Cyril Murray espouses is the use of op-amps instead of resistors for feedback. In conjunction with capacitors, resistors can result in variable time constants. The results with the op-amps are truly phenonemal.

The voltage preamplifiers also contain the control resistors which measure the output current being fed through the output stage, and monitor each half cycle of current to ensure that the pre-set limit is not exceeded. In the event that it is exceeded, the amplifier will automatically limit the current drawn to a lower level and reset on the next half cycle. If the half cycle draws excessive current, it will similarly limit and thereby the process continues until the overload, or short circuit, is removed.

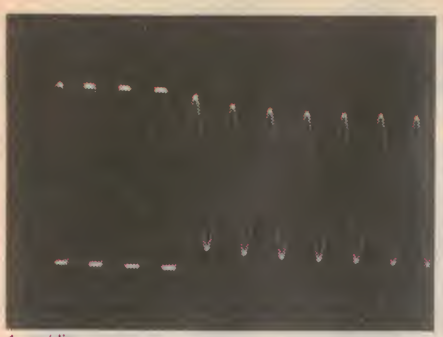
This particular protection feature is very important in professional applications, especially where the user insists on the amplifier continuing to operate, even at a lower power level. Similarly, professional users normally insist on amplifiers resetting themselves without attention. Both of these requirements are neatly met by this amplifier.

The amplifier chassis also contains surface-mounted rectifiers, capacitors and other components which are neatly mounted in the classical manner and clearly labelled for service identification. Each of the separate modules is terminated in a plug or socket to ease assembly, rapid maintenance and general troubleshooting.

Although the amplifier features a reasonable amount of conventional wiring, all of this is properly clipped, harnessed and reminiscent of wiring in devices that I used to see in this country in the late 50s and early 60s.

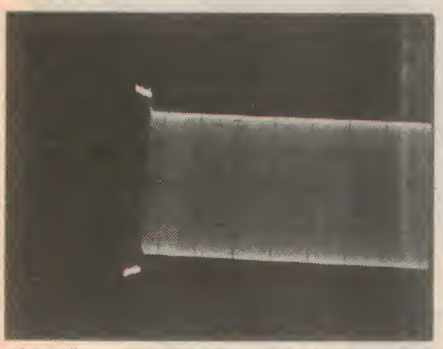
Objective testing

The basic amplifier is a fully balanced transformerless design with a typical 26



1 ms/div

Measured performance of Murray amplifier type MA534, transient overload recovery test (IHF-A-202). 10 dB overload re rated power into 8 ohms, both channels driven. Overload duration: 20 ms; repitition rate: 512 ms.



50 ms/div

kohm bridging impedance and a return loss of greater than 35 dB. The common mode rejection of the amplifier is well above 70 dB from 20 Hz to 20 kHz. This means that the amplifier really can minimise earth-loop problems in critical commercial situations where low level microphone circuits or long cables are involved.

Although the designer makes a strong point of the low distortion characteristics of the amplifier, the literature provided says very little about its ability to drive low impedance loads in the 1 to 2 ohm range. In the unmodified form with the preamplifier control resistors set to their normal position, the amplifier can provide 180 watts into a 2 ohm load which is the same value as it will deliver into a 4 ohm load. Reset to suit the 2 ohm requirement, the amplifier can deliver close to 300 watts of power with the current limit then being determined by the printed circuit board tracks on the pre-amplifier stage.

The amplifier is stated to be unconditionally stable for all loads and frequencies and is fully short circuit protected by means of the protective relays contained on the control board. The basic parameters being offered are obviously more high fidelity than commercial in nature; the features of the output and control circuitry are seemingly just as appropriate for military or quality control laboratory applications. The ABC has specified these particular features for the New Parliament House, Canberra in order to have a universal amplifier which will neatly fit into any possible application.

The frequency response of the unit is obviously dependent on which of the output circuits you select. In the case of the direct line output, this is +0 −3 dB from 15 Hz to 52.5 kHz and is effectively ruler-flat from 50 Hz to beyond 35 kHz. The low frequency slope has been deliberately tailored to reduce the impact and potential danger of dc offsets, which could otherwise destroy speakers when they are connected.

The frequency response with the 100 volt line output transformer selected is effectively 15 Hz to 19.8 kHz for one channel and 14.4 Hz to 18 kHz for the other channel. Whilst the low frequency response is almost exactly the same as that provided by the direct line output, the high frequency response commences its slow droop from 2.5 kHz and smoothly rolls over to a −3 dB point just before the 'magical 20 kHz'. These results are in agreement with the manufacturer's claims.

The noise figure and output characteristics of the amplifier were carefully measured relative to a 1 watt output with the gain set for 0.5 volts input and separately in the maximum gain position. In the 0.5 volt input mode, the A-weighted noise figure is −94 dB (which means that the figure would be −114 dB relative to the 100 watt output condition), whilst in the maximum gain position, the A-weighted figure is −89 dB relative to 1 watt (corresponding to −109 dB relative to the 100 watt condition).

The shape of the third octave spectral analysis was a little unusual featuring a step in the noise curve between the 500 Hz and 630 Hz octave bands which, although strange, was by no means audible or otherwise disturbing. The harmonic distortion levels at the 1 watt level exhibit delightfully low total harmonic distortion (thd) figures which are 0.0013% at 100 Hz, 0.0009% at 1 kHz and 0.0028% at 6.3 kHz. At the 100 watt level, the rise in distortion is absolutely miniscule with a thd figure of 0.0017% at 100 Hz, 0.0012% at 1 kHz and 0.0035% at 6.3 kHz. All of these figures are exceptionally good.

With the 100 volt line ouput transformer connected, the variation in distortion is of marginal significance. The thd figures at the 1 watt level are 0.0016% at 100 Hz, 0.0011% at 1 kHz and 0.0025% at 6.3 kHz. At the 100 watt level, however, the increase in distortion is much greater with the thd figure rising to 0.053% at 100 Hz, 0.004% at 1 kHz, but dropping to 0.0022% at 6.3 kHz. This drop in distortion at high frequencies is achieved because of the filtering characteristics of the output transformer.

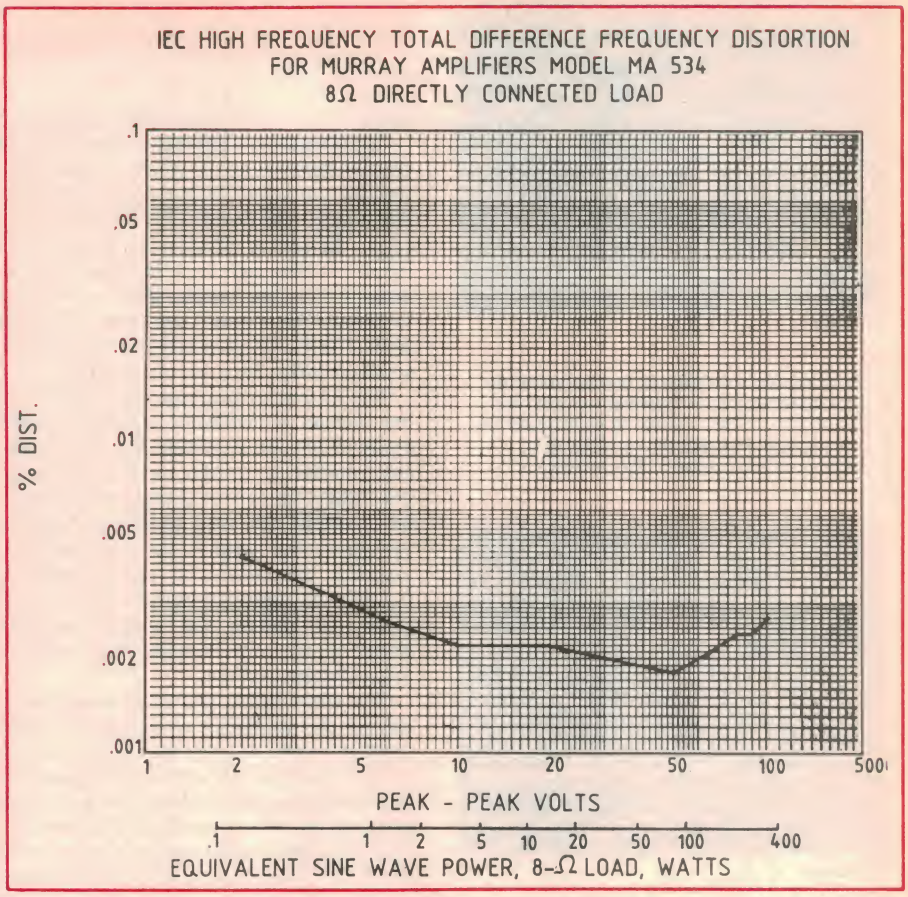
The IEC high frequency total difference frequency distortion characteristics of the amplifier initially proved to be something of an enigma. The amplifier was straight from the production line and, as I subsequently discovered, exhibited an unexpectedly high▶

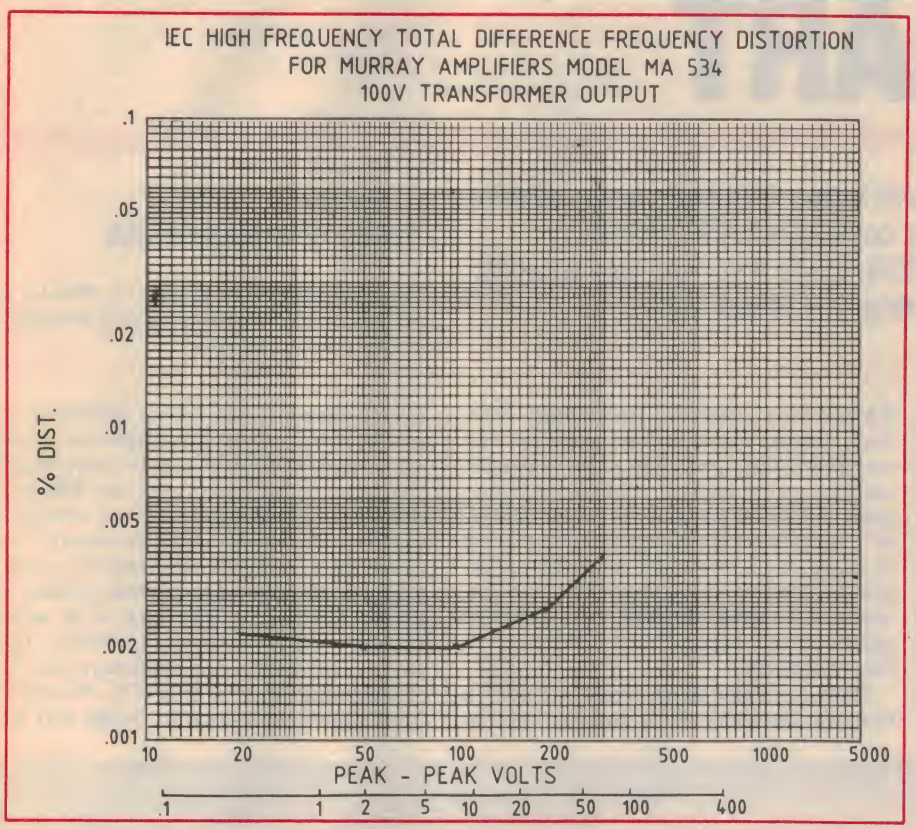
frequency oscillation. As it transpired, this particular unit had not been subjected to the normal quality control checks and was replaced by one that had. With the amplifier cards replaced by "QA" checked units, the performance was entirely different. The distortion figures on the direct line output were then measured at 0.0021% at 1 watt output and 0.003% at the 100 watt output. With the 100 volt line output transformer connected, the distortion figures were still only 0.0021% at the 1 watt level but rose marginally to 0.0036% at the rated power.

The maximum power output at the clipping point in accordance with IHF A-202 test is 156 watts indicating a head room of 1.9 dB. The transient overload recovery test indicates a very slight trace of asymmetry on the first half sine wave (because of the protective control circuitry) but the recovery was in all respects satisfactory.

Subjective testing

One of the most critical tests of an amplifier is its subjective evaluation. This particular amplifier provides one feature which is both unusual and advantageous. Because it has a line input which is directly compatible with a compact disc player and incorporates a remote line amplification control achieved through the use of a simple potentiometer, I was able to evaluate the unit fed by a CD





player connected directly to its input. The speakers were directly connected to the output. The lack of preamplifier or tone control circuitry thereby ensures that minimum distortion, noise and/or colouration results.

I chose a Sony CDP101 and a Yamaha CD500 for the input devices and a B&W 801F monitoring system and Quad electrostatic speakers with Audio Pro sub-woofer for the monitoring systems. Background sound, even with one's ear glued to the speakers, completely disappeared and the eerie sense of 'being there' was quite uncanny.

Dvorak's "Symphonie No 9" with Herbert von Karajan conducting the Vienna Philharmonic Orchestra (DGG 415 509-2), a truly exciting disc, generated a feeling of presence that the amplifier revelled in (and so did I). The amplifier provided a signal, which was crystal clear without being clinical or artificial in any way. The experience was subjectively very rewarding.

The Murray MA534 amplifier is really 'something out of the box'. In the simpler hi-fi version (without the line transformer) it is unquestionably one of the finest amplifiers currently available in Australia. It has performance and functional attributes specifically designed for monitoring CD discs without the need for a separate preamplifier. ●

GET smART

One of the CAD packages around today that puts a sparkle in our draftsman's eye is the lower costing smARTWORK package. Another is PROTEL PCB. Over the next two months we review these packages, starting this issue with smARTWORK.

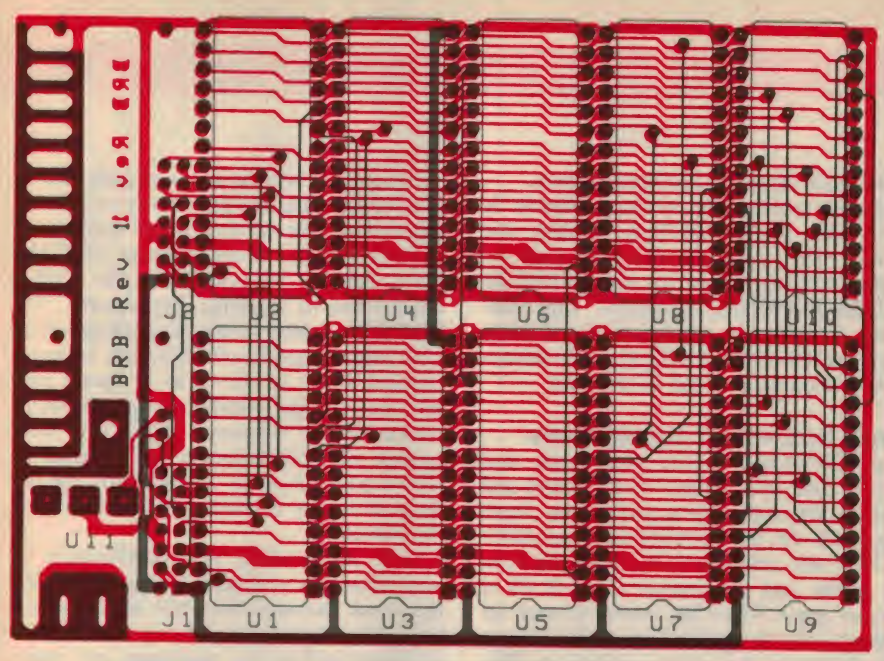
Tony Pugatschew

Tony Pugatschew is lecturer in Physics at the South Australia Institute of Technology at The Levels, Adelaide.

COMPUTER AIDED DESIGN or CAD is one of the most revolutionary tools available to our modern technological society. In the hands of a race that has both vision and purpose the CAD approach means that high quality technological products can be efficiently designed and brought into production.

In a previous article (ETI, July 86) we mentioned that CAD has been slow to take off in Australia. This is hardly surprising. CAD techniques are used by technicians, but Australia has 10 times more lawyers than scientists. Accounting, database, pretty presentation graphics and wordprocessing packages have naturally received more market attention. Another point is that 60 per cent or so of Australia's manufacturing industries are classed as being small, too small to justify an expensive, dedicated CAD system. It is obvious that small bureaux and personal puters must supply CAD assistance to these industries.

Since computer aided design is merely a tool, the capability of the package must be related closely to the task at hand. For example, if we restrict our attention to packages based on IBM-PCs or the biologically inaccurate term 'clones', we can find general drafting packages such as Autocad, Cadplan, Versacad used extensively. Because these products are general systems they can be adapted to provide symbol libraries for specific uses such as in architecture, town planning, electronic diagrams, etc. Electronic simulation and design packages such as P-SPICE, Microcap, Micrologic can be used to design and test



complex electronic systems.

Most modern electronic equipment relies on the placement of the relevant components on a printed circuit board. The design of this board is a marriage of many parts of the human intellect. For instance, the circuit must be designed, components placed to minimize production hassles, the interconnecting tracks must be placed or routed and the whole complex design must be checked. It comes as no surprise that computer aided techniques have replaced many of the past ways of designing and laying out boards. Previously, projects were handled by draftspersons who huddled over a light box sticking down tracks and pads. Changing a section of a layout because of design errors or the introduction of extra components meant redoing sections of the layout, with consequent irritation and frayed tempers.

Computer based packages differ in the complexity and price. The lower priced packages rely on the operator to place components and lay the tracks. Higher priced packages can do the placements and routing automatically. These systems can also work directly from a schematic and hence are preferred tools when dealing with complex, high density boards. In this article, and another next month, we discuss the two lower priced products smARTWORK and PROTEL-PCB which can be used for a variety of designs by relatively untrained operators.

It is important to introduce several terms that will be used extensively in this article. Thankfully, both the American designed smARTWORK and the locally produced PROTEL-PCB have standardised on the use of these terms.

Component side of the board: The upper side of the board where the components are placed. Lettering may be placed on this side and, obviously, it is referred to as the component side text.

Solder side of the board: The underside of the board where the components are soldered.

Pads: Circular or rectangular copper areas where components are placed and soldered on the solder side. The pads are usually available in different dimensions and are placed on a fixed grid of 0.1 inches.

Pin throughs or vias: Small pads that permit a track to swap from one side of the board to the other.

Component overlay or silkscreen layer: It is good practice for ease in loading the final board to have a component overlay silkscreened onto the component side. Outlines and component numbers that are similar to the circuit diagram can assist in debugging the board.

Solder mask: The component overlay is usually printed on a coloured epoxy coating on the board (usually green). This coating is insulating apart from the pad areas so it prevents solder bridges, etc, shorting out tracks. The mask also assists in the production of boards by flow soldering methods.

Pad master: A plot of only the pads on the board. This is necessary to produce the solder mask.

Edge connectors: These are self explanatory apart from the crazy choice of connector spacing. For example, most boards have 0.1 inch spacing between connector fingers but STD bus boards have 0.156 inches.

smARTWORK

This software package is probably the earliest attempt to produce a reasonably priced and simple to use system to design pcbs. The product is produced by the Wintek Corporation which is mainly involved in the production of microprocessor boards for industrial control applications. Since a package was not available that combined the desired features on a PC, some of the engineers and computer staff decided to write their own version and hence smARTWORK was born.

smARTWORK differs considerably from drafting systems that are extended to pcb design since it offers an elementary form of auto routing.

To quote the manual, the program "understands electrical connections". If two conductors or pads are to be joined, the user defines the start and end locations and the program will automatically find the shortest route and draw an appropriate track. This track will not cross other conductors on the same side of the board, and will make numerous bends and turns if necessary. However, the operator can define a path if necessary.

Screen operation is also different being based on a raster display which means that the layout can be smoothly panned through the working window.

smARTWORK can handle the design ▶

TABLE 1. SUMMARY OF smARTWORK

Placement accuracy of components	50 mil
Grid size	50 mil
Maximum pcb size	10 x 16 inches
Zoom window size	complete board, working window
Pad sizes	62, 75 mil round or square
Library of common outlines	designed by user with block commands
Dip pad size	62, 75 mil round
Edge connectors	selected with fat cells only
Track sizes	one size 80 mil
Plot scales	2:1, 1:1 or variable for pen plots
Printer support	dot matrix plot on Epson printers
Plotter output	pad master, component, solder and silkscreen
Multilayer boards	2 layers
Plotters supported	HP and Houston series
Documentation	manual, disk 384K RAM
2 Floppy drives	
Colour graphics adaptor	
Colour monitor	
Microsoft mouse	
Demonstration disk available	

of single or double sided printed circuits and provides a silkscreen layer for a component identification. To minimize defects, smARTWORK enforces certain minimum track spacings. A summary of smARTWORK capabilities is given in Table 1. The completed layouts can be plotted on most plotters and test plots suitable for prototypes can be generated on dot matrix printers.

Getting started

The pcb editor is started with the EDIT command. The smARTWORK logo is then displayed with version and serial number. A blank work screen then appears with a lower status line indicating current cursor position, board side and cursor offset.

smARTWORK commands are either a command line input with text, a display-control function invoked with the ALT key and a function key, or single stroke keystroke functions with the function key.

smARTWORK commands are entered by pressing ENTER or RETURN. A prompt line showing COMMANDS will appear and the command can be entered. Most of the smARTWORK features are divided between the function keys which perform pad, track and screen display options, and command word entries which perform component insertion and block moves.

Moving around the working window is done with the arrow keys or with the mouse. The screen continually pans or moves with no need to use ZOOM or SCREEN RECENTRE command. This indicates a different presentation strategy from the PROTEL-PCB. A short discussion of features is useful at this time.

Pads and edge connectors

smARTWORK offers two types and sizes of pads: 62 mil and 75 mil round and square. When placing a pad on any layer using the F3 (place pad) key, smARTWORK will create a 62 mil pad on both the solder and component sides. If F3 is pressed again when the cursor is over an existing pad the pad's size and/or shape will change to the next combination. The video display shows the appropriate shape for round and square pads, but due to the limited resolution of the display, no distinction can be made between 62 and 75 mil pads.

The status line indicates the pad size so a check can be made on the selected pad at a certain point. It is possible to change the default pad size when the editor is commenced by typing >EDIT-P75r for use of 75 mil round pads. Pads are removed by placing the cursor over the pad and pressing F4. The placement of pads can be assisted by using the ALTF9 key to turn on a dotted grid based on a 50 mil spacing.

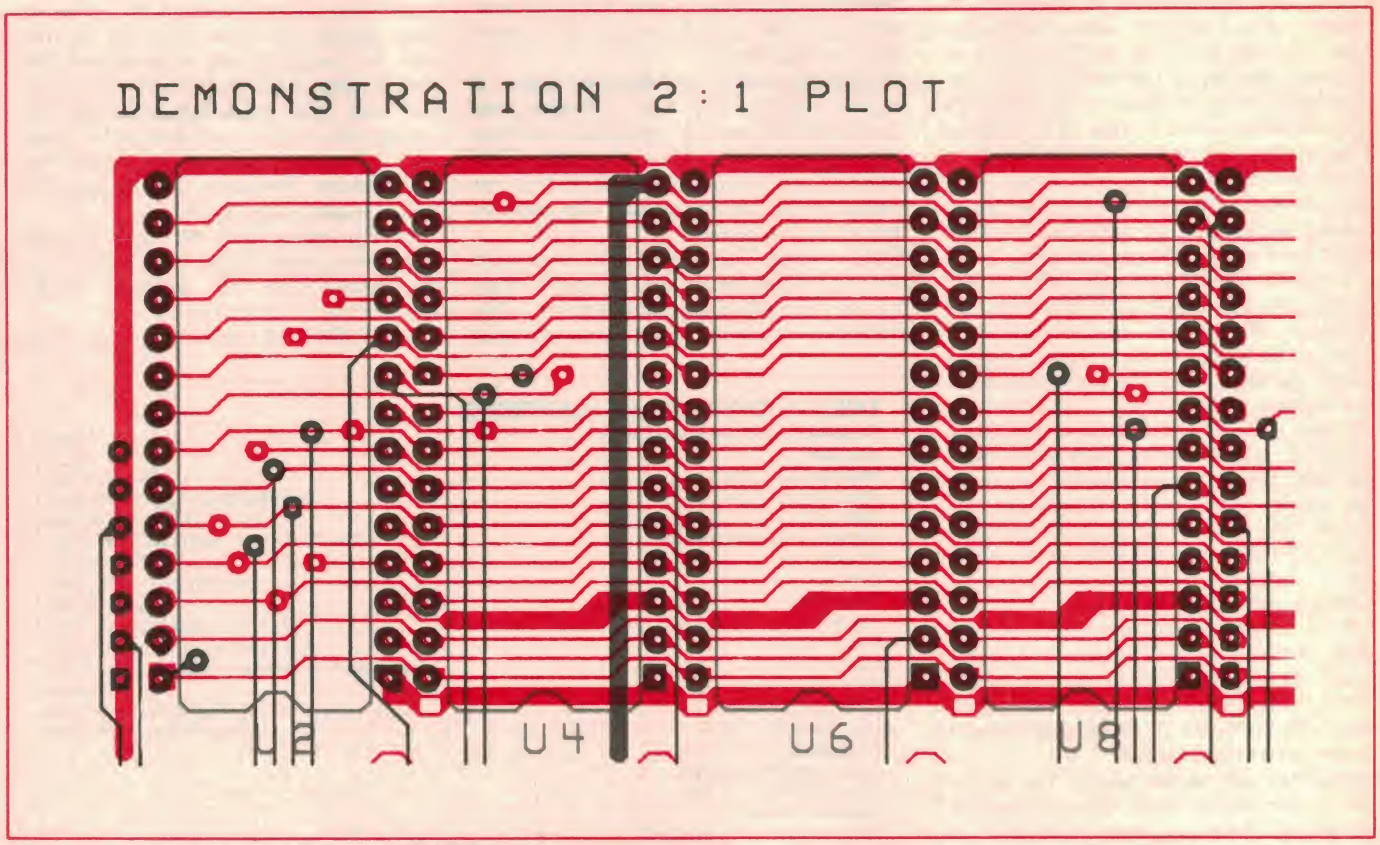
Repetitive pad shapes such as DIPS and SIPS can be inserted from the COMMAND line by entering, for example, DIP S 28 6 for a dual in-line IC package of 28 pins running south with 0.6 inch between centres. Pin 1 is shown as a square pad and an overlay outline is automatically drawn on the silkscreen layer. The DIP outline normally appears as a rectangle with a notch at pin 1. Smaller DIP separations of 0.1 or 2.0 will appear outside of the two rows.

If a nonstandard pad combination is used then this unit may be repeated with the block features that will be discussed later. The construction of edge connectors is constrained to the minimum grid spacing of 50 mils and can be made from a 'Fat Track' or placing fat bits with the F5 or F7 commands respectively.

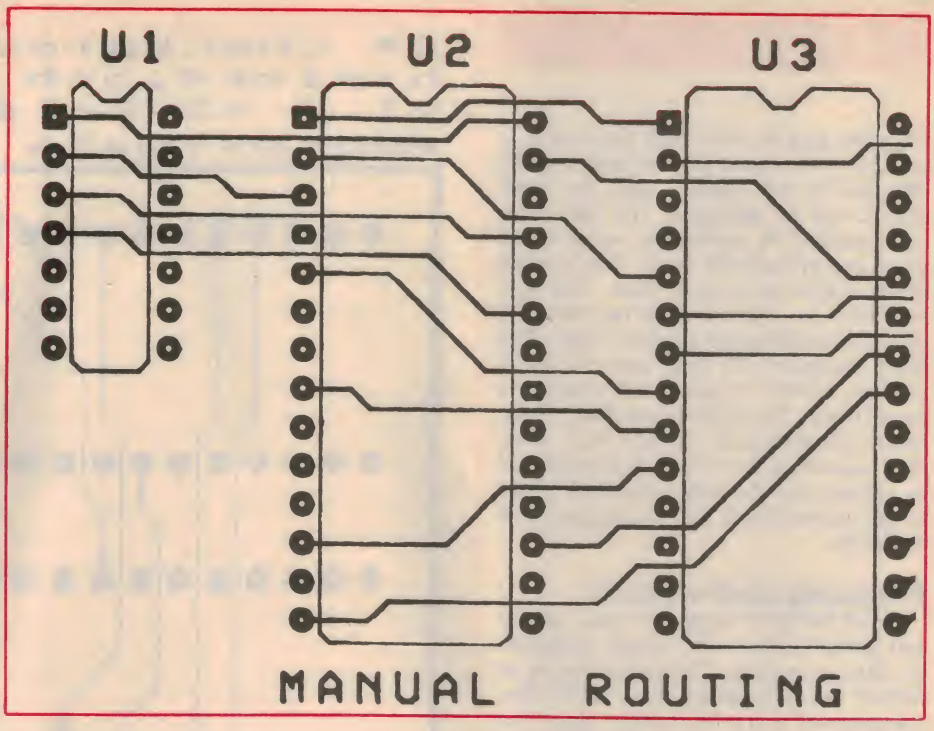
Elementary track laying

There are three working layers in smARTWORK: the component side, solder side and overlay or silkscreen side.

The colours of the various layers can be selected by several means. By pressing the ALT-F1 key, the user is able to switch between a single layer displayed in one co-



2:1 artwork is also possible with smARTWORK.



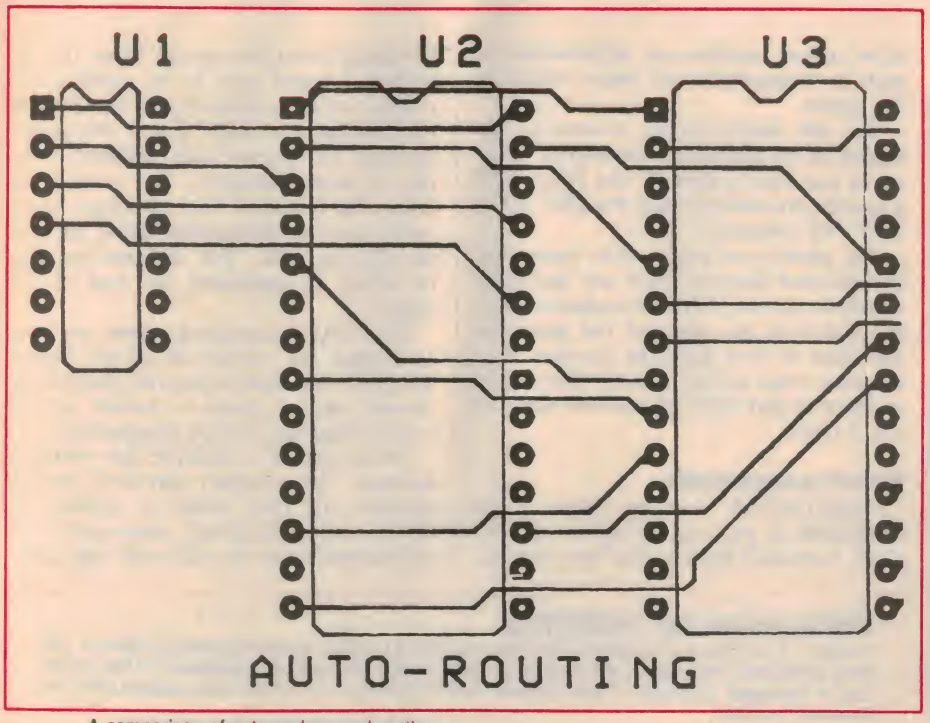
lour. ALT-F2 toggles the intensity of the background colour. ALT-F3 permits two palettes of colour to appear on the screen: red, yellow and green, or magenta, cyan and white. ALT-F4 displays switches the background from black to blue and ALT-5 displays two or three colours at one time. The colour of the active layer can be selected with the ALT-F6 combination. Finally, ALT-F7 permits the entire 10 by 16 inch design screen to be viewed at once in monochrome. This is a poor resolution view but can be useful to see if extra components, etc, can be added.

The working layer is selected by using the − and + keys. For example, if we are working on the solder side or lower layer and the + is pressed we will move to the component layer. Another + entry will move to the silkscreen layer. This logical system will then cycle up and down the layers without any problem. The selected layer is displayed on the status line as SIL, COM or SOL to remove confusion.

To start a track place the cursor on the start point and press F1. The normal square cursor is replaced with a small three line block to indicate that routing has been selected. The cursor is then moved to the destination point and F1 is pressed again. Depending on the complexity of the track the shortest path track is drawn between these two points automatically.

In the initial stages of the layout when the board is devoid of tracks this does not produce the best pcb design. The tracks tend to be too close to pads, and use many sharp bends and turns. The user can manually place a track by going to the start point, pressing F1 and then moving the cursor and repeating the F1 command. Comparisons of these two methods are shown here. The current version of smARTWORK has considerably optimized track laying algorithms but lengthy and tortuous paths may still occur.

A track section may be replicated with the track copy function by pressing the F8 key. The previous track will be repeated.



A comparison of auto and manual routing.

Text placement

Text can be placed on any of the layers. Obviously, text on a signal layer will be etched in copper and overlay text will be printed in ink. To place text, move to the desired layer (using the + or − keys). Move the cursor to where the text will begin and enter the command line>TEXT x.

The x is the compass direction of text with respect to the cursor and can be n, s, e, w, the default compass direction is on the solder layer and e for the component and silkscreen layers. That is, the text is automatically mirrored on the solder side. If no x term is specified, the text is assumed to be mirrored or in the American vernacular "wrong-reading". It would be interesting to see the Japanese or Taiwanese translation of this term. Text can be removed by placing the cursor on the text and using the F2 key (remove route function) or the right mouse button. Text is available in one size and existing text can be moved or rotated only with the block option.

AREA FILL command

The FILL command fills a specified layer of a block or the smallest rectangle that completely encloses the non-empty portion of the workspace with fat cells. To invoke the FILL command enter COMMAND>-FILL 1. Removal of a filled block can be performed with the -FILL command.

Block commands

The block concept allows greater flexibility in manipulating areas of the layout. A block is a set of three congruent rectangles, one for each layer that defines a section of the workspace. To mark the first corner of the block, the cursor is placed at ▶

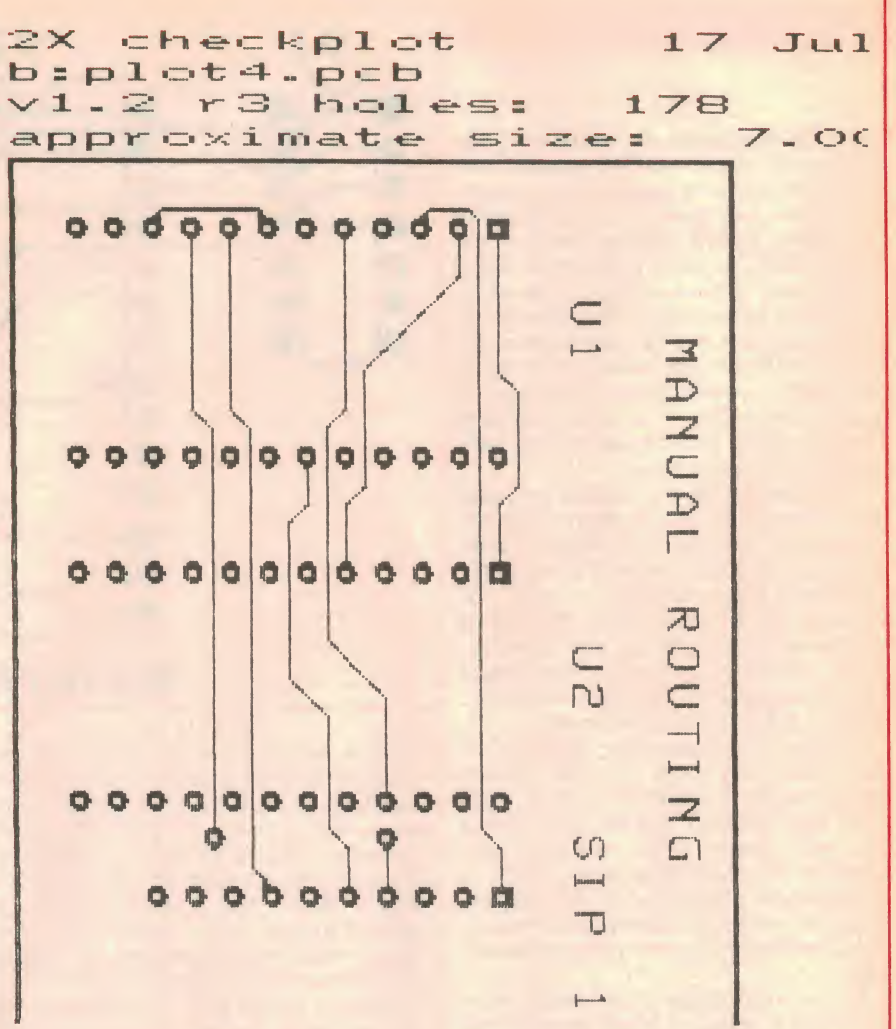
the point and the F9 (mark block) key is pressed. If the status line has been toggled off, then it will appear, and the word BLOCK will be displayed. The other corner is marked by moving the cursor to the point and pressing F9 again. The marked block appears in reverse video. The normal video is restored when the cursor is moved away from the marked block. The SAVE command will then save this block and the LOAD command will load in a saved block. The MOVE and COPY commands will permit the marked block to be manipulated on the screen. It is important to realize that the interconnecting tracks to the marked block are not dragged with the block.

Preparing final artwork

smARTWORK supports both plotter and printer output with special programs for these functions. The plot program in normal use will prompt for a layout file, communication port and plotter type. The program also generates a plot file if the communication port is replaced with a file name. A temporary intermediate plot file can also be created that, when executing, minimizes the delay in plotting. This removes problems of ink drying in the pen.

Command line options select trace widths with the PLOT -w 16 (16 mil trace); the trace separation is 17 mils in this case. The PLOT — w 20 command plots 20 mil lines and 15 mil spacing. The border which is drawn around each plot can be suppressed and the baud rate can be selected with the PLOT -bx command. The plot can also be scaled to other magnifications with the PLOT -sf command. The primary use of this scale factor is to allow minor axis-by-axis adjustments to plots to compensate for linear errors in the plotter.

Plotter.



Dot matrix printer output.

The dot matrix plotter commands are similar to the pen plotter commands. A x1 check plot can be selected and drawn with a rotated presentation with the DOT -r0 or DOT -r90 command.

The plotting program offers some very sophisticated features. Pads are shaved to maintain the conductor-to-conductor spacing and both the plot and dot programs will fillet or tear drop the junction of a diagonal trace and a fat cell. This occurs in the pen plot files and also the dot matrix 2:1 plot.

Extra commands

smARTWORK features some extra commands it pays to be aware of. The STAT command provides the user with information about the current layer: the appropriate board area to be plotted, the number of each type of pad, the present and maximum number of text characters, the pad, the present and maximum number of text characters, the number of holes, the estimated area of copper to be used, and the appropriate space to save the file on disk. This information may be useful in estimating the cost of the board.

The COLOR command allows the user to control the colours of all the layers. The final command allows the board to be cleaved or cut about a certain axis in order to squeeze in extra components.

The command is CLEAVE d,w where d indicates the compass direction and w specifies the cleft width in numbers of 50 mil units. Electrical connections are maintained across the cleft with thin cells.

INSTALLATION AND PROTECTION

Version 1.2 revision 3 is supplied on a single disk with a complex software protection scheme. The local distributors manufacture the disks in Australia and promise speedy replacement if the master disk is damaged. Upgrades to new versions cost in the order of $50 and are available from the Australian supplier.

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3	28	53	78	103	128	153	178	203	228	253	278	303	328
4	29	54	79	104	129	154	179	204	229	254	279	304	329
5	30	55	80	105	130	155	180	205	230	255	280	305	330
6	31	56	81	106	131	156	181	206	231	256	281	306	331
7	32	57	82	107	132	157	182	207	232	257	282	307	332
8	33	58	83	108	133	158	183	208	233	258	283	308	333
9	34	59	84	109	134	159	184	209	234	259	284	309	334
10	35	60	85	110	135	160	185	210	235	260	285	310	335
11	36	61	86	111	136	161	186	211	236	261	286	311	336
12	37	62	87	112	137	162	187	212	237	262	287	312	337
13	38	63	88	113	138	163	188	213	238	263	288	313	338
14	39	64	89	114	139	164	189	214	239	264	289	314	339
15	40	65	90	115	140	165	190	215	240	265	290	315	340
16	41	66	91	116	141	166	191	216	241	266	291	316	341
17	42	67	92	117	142	167	192	217	242	267	292	317	342
18	43	68	93	118	143	168	193	218	243	268	293	318	343
19	44	69	94	119	144	169	194	219	244	269	294	319	344
20	45	70	95	120	145	170	195	220	245	270	295	320	345
21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
23	48	73	98	123	148	173	198	223	248	273	298	323	348
24	49	74	99	124	149	174	199	224	249	274	299	324	349
25	50	75	100	125	150	175	200	225	250	275	300	325	350

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POST TODAY!

ABOVE AND BEYOND — the R7000 from Icom

Icom seems to release a new product before the old one has time to cool. The latest in its range will cover up to 2 GHz. Is this the definitive scanner?

Andrew Shipley

Andrew Shipley is technical consultant with Associated Calibration Laboratories.

THE R7000 is not your usual run-of-the-mill scanning receiver. It is aimed at the home user, and has many of the bells and whistles that the smaller portable machines lack.

It's most unusual feature is a bandwidth that goes all the way up to 2 GHz.

Is there much interest in the gigahertz bands? About the only use of the band between 1 GHz and 2 GHz is the 1296 MHz amateur band but there are still relatively few of these stations operating. By nature these frequencies require specialised reception equipment, high gain parabolic antennas, low loss coaxial feeders and propagation characteristics that dictate highly directional line of sight transmission paths.

Microwave transmission links used by TV stations might be a target. They are typical of this sort of operation. But as these are point to point contacts, unless you are situated in the link path, you are unlikely to hear anything.

Frequency and sensitivity

Until now the highest coverage in a commercial scanner was that of the AOR AR-2002 (see April ETI) from 25 to 1300 MHz with two bands 25 to 550 MHz and 800 to 1300 MHz.

The R7000 has two gaps, one at 87.5 to 108 MHz (FM broadcast) and the other between 1000 MHz and 1025 MHz, the latter being a function of the design. We understand that receivers covering the FM broadcast band will be available but with a different duty rate.

With this sort of frequency range it's possible to tune to a variety of stations: CB, amateur, aircraft, marine, emergency services, government and television bands being some of the possible choices.

All modes are catered for, FM in three bandwidths (6 kHz, 15 kHz or 150 kHz), AM and both sidebands. These are coupled with a choice of tuning increments from 0.1, 1, 5, 10, 12.5 and 25 kHz to give the receiver excellent coverage.

In previous articles we have pointed out that manufacturers can be somewhat misleading when quoting sensitivity specifications. To be strictly correct, sensitivity must be quoted at a specific frequency mode and bandwidth for a given result (S/N or SINAD). An example of the correct way of stating receiver sensitivity is 0.5 μv FM (6 kHz, B/W) at 140 MHz for 12 dB SINAD.

Icom appears to be fairly confident, as it has quoted sensitivity with all these above parameters included. There are two bands, 25 MHz to 1 GHz and 1240 to 1300 MHz, with no specifications between 1000 and 1240 MHz or above 1300 MHz.

The manufacturer includes no specifications above 1300 MHz and the reason for this became readily apparent upon investigation. The receiver has very poor performance here. Although it's difficult to design a receiver front end capable of covering 25 MHz to 2 GHz it's not impossible given the jumps in receiver technology that have occurred of late.

Internally generated spurious signals, or 'birdies' as they are commonly known, are present in most receivers to some extent, but the R7000 was disappointing in the large number that were apparent (see test results).

Receiver set on 500 MHz; measured with HP141T spectrum analyser, scan width: 0-2 GHz, 100 kHz B/W, ref -30 dBm.

Receiver set on 1500 MHz; measured with HP141T spectrum analyser; scan width: 0-2 GHz, 100 kHz B/W, ref -30 dBm.

Spurious outputs from antenna terminals.

There were quite a few of these signals that had equivalent signal levels in excess of 5 μV particularly above 1000 MHz. Whilst scanning, these birdies can cause the receiver to stop scanning and remain stopped. This can, in most cases, be overcome by setting the squelch level higher, but due to the strength of some of these signals this is not always possible.

Features

Our test unit came with the optional voice synthesizer that announces the operating frequency when the front panel speech button is depressed.

Whenever the squelch is opened the voice synthesizer announces the frequency through the tape jack as well. This tape jack is normally used for recording.

Optional infrared remote control operation is available for those without the inclination to leave the comforts of their lounge chair when using the receiver. Our unit was not equipped with this option so we unfortunately cannot comment on its use.

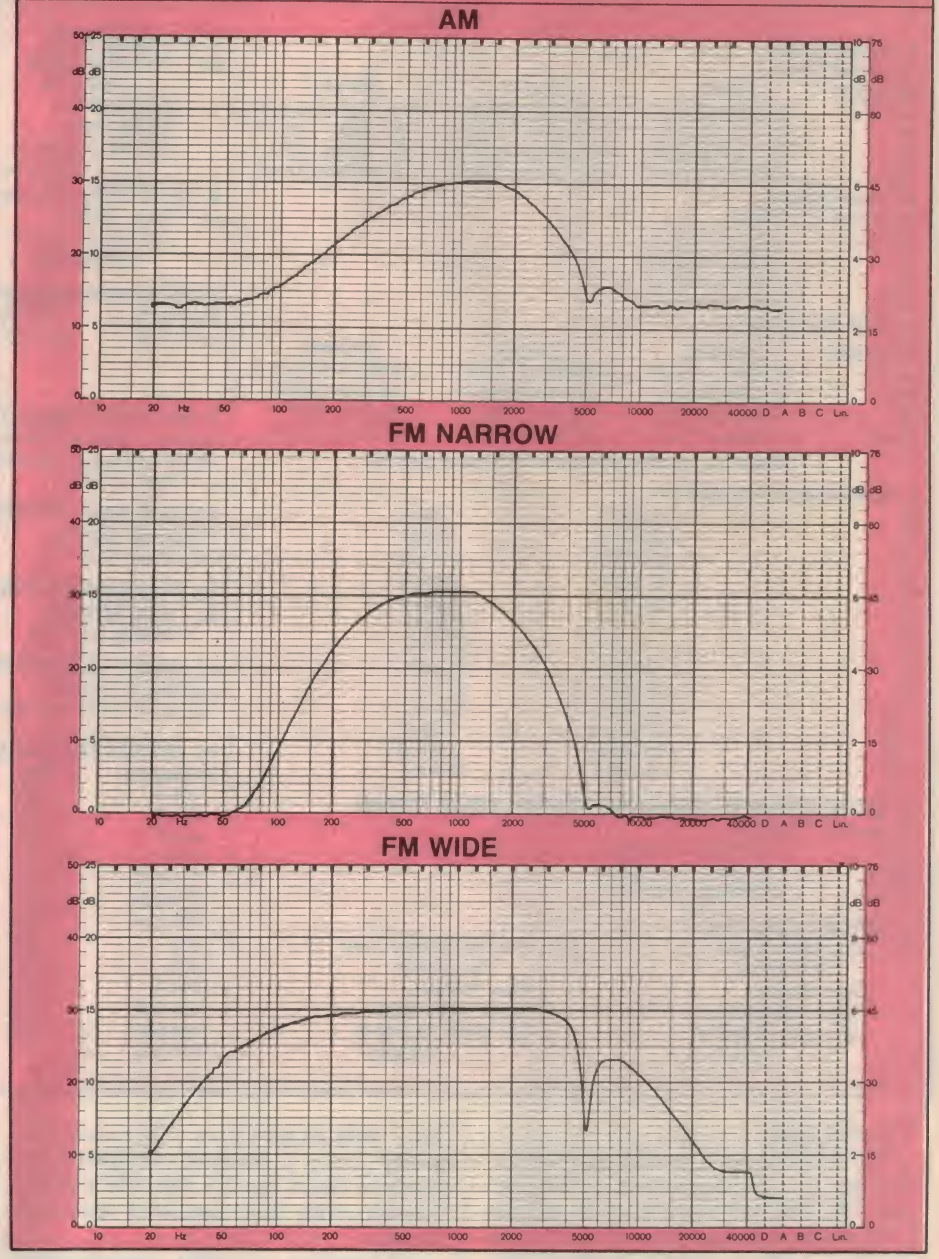
Frequency control is via the data keyboard or the frequency spinwheel. There are six switch-selectable frequency increments. The number of possible combinations of frequency scanning is impressive and caters for all types of listeners.

In addition to these there is the voice scan control (VSC) which will, when scanning, lock only on channels with audible *voice* signals.

Ninety-nine memory channels are available with channels 80 through 99 dedicated to the auto memory write function.

The squelch control has a dual function. The first half turn of the knob is the usual noise squelch but the latter half is a signal strength squelch allowing only signals stronger than the level indicated on the S meter to be heard. This is a feature found only in expensive commercial equipment and is a most pleasing addition.

RECEIVER AUDIO RESPONSE (ACL PTY LTD).



Some of the other features are attenuator switch, dial lock, dimmer, scan delay, scan speed, S meter, frequency centre meter and noise blanker.

The test receiver was supplied with Icom's new AH-7000 Super Wideband Omnidirectional Antenna. This antenna is a discone which covers the range of 25 to 1300 MHz on receive and can be used with a transmitter up to 200 W on 50, 144, 430, 900 and 1200 MHz. It comes complete with a length of coaxial cable, is 1.7 metres high and weighs just 1 kg.

It's extremely well constructed. On air operation is excellent, giving good results pulling in marginal signals all across the band.

As the antenna is one of the most important considerations when assembling a communications facility those of you wanting to upgrade from a bent coathanger should look no further. The AH-7000 is an excellent all round antenna with an RRP of $199 approximately. ▶

LABORATORY TEST FIGURES ICOM IC-R7000 S/N 01086 WITH IC-EX310 MODULE

1. SENSITIVITY

(a) 25-999.999MHz

Measured	25MHz	500MHz	900MHz
FM(N)	−121.5dBm(0.18μV)	−117.4dBm(0.3μV)	−117 dBm(0.31μV)
FM	−113 dBm(0.5μV)	−110.5dBm(0.67μV)	−108 dBm(0.89μV)
AM	−111 dBm(0.63μV)	−108 dBm(0.89μV)	−107 dBm(0.99μV)
SSB	−125.5dBm(0.12μV)	−123.5dBm(0.15μV)	−120.5dBm(0.21μV)

(b) 1240-1300MHz

Measured @ 1270MHz

FM(N)	−112dBm (0.56μV)
FM	−103dBm (1.58μV)
AM	−108dBm (0.89μV)
SSB	−114dBm (0.45μV)

(c) 1300-1999.999MHz

Measured	1400MHz	1700MHz	1900MHz
FM(N)	−104dBm(1.4μV)	−86dBm(11.2μV)	−74dBm(44.6μV)
FM	− 91dBm(6.3μV)	−80dBm(22.4μV)	*not measurable
AM	− 78dBm(28.2μV)	−76dBm(35.4μV)	−68dBm(89μV)
SSB	−110dBm(0.7μV)	−88dBm(8.9μV)	−77dBm(31.6μV)

* Could not be measured because of noise present.

2. S METER SENSITIVITY

S1	−103.6dBm	1.48μV
S2	−99.6dBm	2.34μV
S3	−96.3dBm	3.42μV
S4	−91.9dBm	5.68μV
S5	−88.0dBm	8.89μV
S6	−83.0dBm	15.8μV
S7	−77.6dBm	29.4μV
S8	−72.3dBm	54.2μV
S9	−66.9dBm	101μV
+10	−56.7dBm	327μV
+20	−46.2dBm	1.09μV
+40	−28.9dBm	7.99mV
+60	−9.4dBm	75.4mV

3. M.D.S. (Minimum Discernible Signal): NOISE FLOOR

Frequency	: 500MHz
AM	: −125.2dBm (0.122μV)
FM(N)	: +125.8dBm (0.114μV)
SSB	: −132.6dBm (0.052μV)

4. IMAGE REJECTION

(a) 25.512MHz Band
FM Narrow
Freq: 250MHz
Image: 1807.4MHz
Lab result: 78.6dB IF Rejection

(b) 512.999.999MHz Band
FM Narrow
Freq: 750MHz
Image: 1283.4MHz
Lab result: 78.6dB IF Rejection

5. IF REJECTION

(a) 25-512MHz Band
FM Narrow
Freq: 250MHz
IF: 778.7MHz
Lab result: 70dB IF Rejection

(b) 512-999.999MHz Band
FM Narrow
Freq: 750MHz
IF: 266.7MHz
Lab result: 89.6dB IF Rejection

6. BLOCKING (Dynamic Range)

(a) Freq: 250MHz
Lab result: 72.6dB DR Blocking

(b) Freq: 500MHz
Lab result: 73.5dB DR Blocking

7. IMD (Intermodulation Distortion)

Frequency	: 249.98MHz
Lab result	: 81.6dB

8. SQUELCH SENSITIVITY

Frequency	: 500MHz
AM	: 0.07μV
FM	: 0.06μV
SSB	: 3.26μV

9. RECEIVER RADIATION (Antenna Socket)

Highest −66dB at 580MHz
With 2 GHz range selected spurious signals rose dramatically with the highest at −42dB at 1GHz.

10. INTERNAL ATTENUATOR

Frequency: 250MHz
Lab result: 19dB

11. FREQUENCY STABILITY

(a) Freq: 500MHz
Result: 2ppm low

(b) Freq: 1260MHz
Result: 2ppm low

12. AUDIO OUTPUT POWER

Impedance: 8 ohms
Lab result: 3.125W for 5% distortion

13. AUDIO DISTORTION

Result: 3.7% minimum

14. INTERNALLY GENERATED SPURIOUS (BIRDIES)

Frequency	dBm	μV
409.6	−88	8.9
445.6	−91	5.7
614.4	−96	3.4
768	−91	5.7
1111.111	−91	5.7
1333.333	−67	101
1444.444	−100	2.3
*1500	−37	3.15mV
1536	−104	1.5
1614.4	−100	2.3
1666.666	−72	54
1888.888	−104	1.5
1999.999	−72	54

Note:
Many other birdies were noted but were less than −104dBm and were mostly at frequencies above 250MHz.
* Very high figure.

Technical

The R7000 is not a technological breakthrough, just an extension of existing designs. The front end of the receiver, without a doubt the most important section of any wideband unit, is fairly standard with switched bandpass filters feeding a discrete wideband rf amplifier. It's disappointing really, considering the hybrid devices available now.

Operation above 1 GHz is achieved by inserting an extra high-pass filter and mixer section that converts the incoming signal back down to the 25 MHz to 1 GHz band (a simple down-converter). Not a particularly adequate technique as can be seen by the sensitivity and spurious signal figures above 1300 MHz.

Two different local oscillators are used to give two IF frequencies, one of 778.7 MHz for the 25 to 512 MHz band and one at 266.7 MHz for the 512 to 1 GHz band. Following this is a standard arrangement of bandpass filters and the AM, FM and SSB detectors with their associated bandwidth sections.

All functions are under microprocessor control with the CPU having an RS232 interface output and control lines for the options of remote control and speech synthesizer.

On air operation

Operation of all controls is precise and effective with a well layed out front panel. As with all the equipment from this manufacturer the receiver is attractive with all switches and knobs marked clearly. The general appearance, shape, etc, follows the format originally set with the IC701 transceiver series some years ago.

Subjectively, reception was clear although it takes some time to familiarize oneself with the numerous ways of scanning and memorizing frequencies. The receiver, when operated with the correct antenna arrangements, gave excellent results on any of the commonly used VHF-UHF frequencies.

Overall

The Icom IC-R7000 has more functions and extra features than any of the wideband communications receivers/scanners on the market today. It's neat externally and well designed internally with most of the rf front end sections in individual shielded assemblies. It is a well presented unit and with an RRP of $1850 (approx) it would be most attractive to those Icom black box collectors who want a receiver with the lot. Now if it also covered below 25 MHz it would be one hell of a box! Maybe next year? ●

New IC-R7000

Introducing a Professional Scanning Receiver at an Affordable Price.

25-1000 MHz Plus!

frequency coverage
(no additional module required for coverage to approx. 2.0 GHz.)

ICOM announce a scanning receiver that offers professional performance with IC-R7000 advanced technology – 25-1000MHz coverage, multi-mode operation and a sophisticated scanning and recall system.
IC-R7000 covers aircraft, marine, business, FM/AM broadcast, amateur radio, emergency services, government and television bands.

ICOM IC-R7000 has many outstanding features.

- **99 MEMORIES:** You can store up to 99 of your favourite frequencies for instant recall. Memory channels can be called up by simply pressing the memory channel knob or direct through the keyboard.
- **KEYBOARD:** Tuning can be quickly achieved by selecting precise frequencies directly through the IC-R7000 keyboard or by turning the main tuning knob.
- **SCANNING:** Instant access is provided to commonly used frequencies through the scanning system. The Auto-M switch enables signal frequencies to be memorized while the IC-R7000 is in the scanning mode. Frequencies that were in use can be recalled at the operator's convenience.
  An optional voice synthesizer automatically announces the scanned signal frequency to ease problems with logging.
- **MULTI MODE:** Push button selection enables FM wide/FM narrow/AM/SSB upper and lower modes to be received.
- **6 TUNING SPEEDS:** 0.1, 1.0, 5, 10, 12.5 and 25 kHz through knob selection.
- **ADVANCED TECHNOLOGY CONSTRUCTION:** The IC-R7000 has dual colour fluorescent display with memory channel readout and dimmer switch.
  Dial lock, noise blanker, combined S-meter and centre meter. Optional RC-12 infra red remote control operation. All the above professional features are produced in a convenient, compact unit of size:

Height	282mm
Width	286mm
Depth	276mm

- Specifications guaranteed from 25-1000MHz and 1260-1300MHz.
  No additional module is required for coverage to approximately 2000MHz. No coverage is available from 1000-1025MHz.

Please send me details on: ICOM 3353

☐ IC-R7000 ☐ ICOM's full range of communications equipment.

Senders details:

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ADDRESS _____

_____ POSTCODE _____

PHONE: _____ (BUSINESS) _____ (HOME)

POST TO: ICOM, 7 DUKE STREET, WINDSOR, VICTORIA, 3181. PH: (03) 529 7582.

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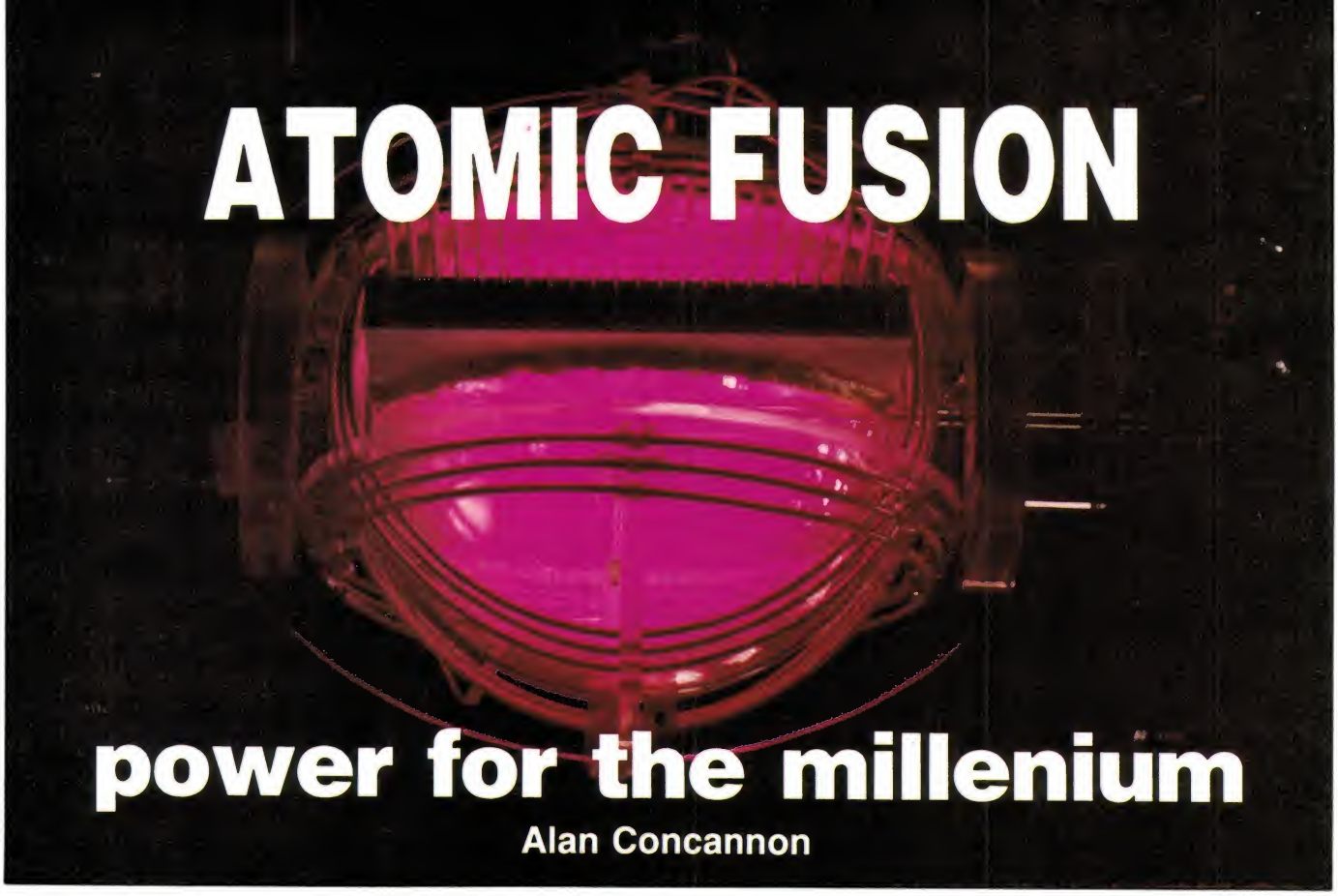


power for the millenium

Alan Concannon

Scientists and engineers have dreamed about atomic fusion since the days of Einstein. It will make the ultimate power source. But 'twixt the dream and its realization are some formidable problems.

THE RESULTS OF 30 years of concentrated research on fusion reactors is at last bearing fruit. Around the world, scientists are cautiously optimistic that their labours will be rewarded in the forseeble future.

Predictions by leading R&D engineers indicate that by the year 2010 fusion reactors should be in place on a commercial basis. The cost will be comparable to conventional coal or oil fired stations, but the energy source will be inexhaustible and the polution negligible.

If this is so, then fusion will be coming on line none to soon. Power generation is shaping up as a major problem. There is fear of nuclear fission, and events at Chernobyl have not eased anyone's anxiety. There is the cost and decreasing availability of oil. Coal is controversial because of its products of air polution and CO_2 build up. Atomic fusion will solve all these problems.

What is fusion energy?

The raw material for fusion is simply sea water. This is plentiful and globally distributed. Its inexhaustible quality is an advantage fusion shares with solar power. However, on a cloudy day solar cells deliver little power. Fusion energy is far more reliable.

The seas contain enough deuterium to power the world with fusion energy for millions of years. Tritium, the other basic fuel in fusion reactors, is bred in the reactor itself and is therefore also unlimited in quantity.

In a fusion reactor, nuclei of deuterium and tritium (both isotopes of hydrogen) are fused at an intense temperature. In the process, a portion of the mass of the nuclei is converted into enormous amounts of energy in the form of neutrons and alpha particles that break-off at high speed from the fusion reaction. The alpha particles bombard and are stopped by the wall of the reactor chamber. The speeding neutrons pass through the wall, colliding with and being stopped by lithium atoms in a blanket surrounding the reactor wall. The collisions produce tiny fission reactions that have tritium as a by-product. The tritium is then recycled with more deuterium (from the sea water) to fuel and maintain the energy giving reaction.

The collisions produce intense heat, approximately 100 million degrees Celsius. The heat is then transferred by a heat exchanger system to produce steam for conventional turbine generators. Although tritium is radioactive, it is only one thousandth as radioactive as uranium in fission reactors. Tritium has a short life of 12.7 years and does not concentrate or linger in living tissue. Also, most of the waste material is recycled back into the reactor — environmentally it is benign compared to fission fuel.

An extremely complex form of technology is needed to initiate, contain and control a fusion reaction. The concept of design is a simple one, but there are still formidable design difficulties to overcome. Presently there are two methods on the drawing board for generating a fusion reaction — magnetic fusion reactors and initial confinement reactors.

Towards fusion: hydrogen plasma discharge in Rotamak rotating field experiments of Atomic Energy Commission.

Magnetic fusion reactors

With this method gaseous deuterium and tritium are injected into a reactor chamber. There, the gas is heated to more than 100 million degrees Celsius. So hot, in fact, that it exists in a fourth state of matter known as a plasma. In this state the deuterium and tritium nuclei fuse. Because there is no material today which can withstand such temperatures, powerful magnetic fields produced by magnetic coils surrounding the chamber contain and compress the plasma, suspending it in the vacuum inside the chamber. The plasma is continuously heated and refuelled. As it burns, neutrons and alpha particles are emitted.

Initial confinement reactors

With this type of reactor a tiny, solid pellet containing frozen deuterium and tritium is shot into the reactor chamber. As it enters the chamber, laser or particle beams bombard it through several portholes in the wall of the chamber. They converge on the pellet, injecting it with several trillion watts of power. This vaporizes the outer surface of the pellet causing an inward explosion. The implosion fuses the deuterium and triti-

um. A strong pulse of neutrons and alpha particles is immediately released. The cycle continues by shooting pellets into the chamber at the rate of five pellets per second. Each pellet is approximately one cubic millimetre.

Neutrons streaming from the pellet implosion are stopped by jets of liquid lithium forming a blanket inside the first wall. Tritium is bred in the blanket and the heat generated turns water in adjacent cooling tubes into steam to drive a turbine.

Progress to date

The world's most advanced operating fusion reactor is at the Plasma Physics Laboratory of Princeton University. On Christmas Eve in 1982, the first plasma was generated in its Tokamak reactor. Since then, plasma currents of more than one million amperes and lasting longer than a second, have been routinely generated. Researchers at Princeton are optimistic and expect to reach break-even energy production by 1986.

Break-even energy production is defined as the level at which energy generated by the fusion reaction is equal to the energy required to sustain the reaction.

During 1983, the joint European Torus, a Tokamak funded by the Commission of the European Communities, produced and confined its first test plasma. Since then plasma currents of more than 1 million amperes have been produced in the test device at the British Atomic Energy Authority's Culham Laboratory. They hope to achieve break-even energy production by 1989.

On 3 November 1983, scientists at the Massachusetts Institute of Technology USA, using its Alcator C Tokamak test reactor, achieved for the first time condition critical to break-even energy production. Using a deuterium plasma a 17 million degree Celsius plasma was contained for 50 milliseconds. Energy break-even would occur at the same condition in a deuterium — tritium plasma, if the temperatures were raised to 100 million degrees. This particular reactor is not designed for the higher temperatures.

The foregoing test reactors are not fitted with first walls, blankets or cooling systems. They are designed only to produce scientific data about plasmas.

Engineering problems

Present design and testing has been focused on generating plasmas in test devices. Other major areas which still need designing are the first wall of the reactor, the blanket and the cooling system. These, together with the so-called drivers (these first ignite the fusion plasma), are all scheduled for inclusion in the engineering test reactors that will be built in the 1990s. At this stage, it is envisaged that the potential of fusion for economic power production will be clearly defined.

In the next two years, the fusion projects must achieve break-even energy production. To do this, stronger magnetic fields in the magnetic fusion reactors have to be confined for longer periods and temperatures nearer 100 million degrees Celsius must be reached. But once the major obstacles of achieving break-even energy production are overcome the other design problems can be tackled in detail.

The high temperature involved in fusion reactors is an obvious problem. Fusion scientists have known for some time that materials to contain these high temperatures (100 million degrees C) would probably limit fusion-reactor development more than any other single item. The choice of materials for the first wall is also critical. This wall is continually bombarded with high-energy neutrons — energies of 14 million electronvolts are expected in most commercial reactors. Such a barrage makes the wall brittle and radioactive over time.

Austenitic steel (one of many steel alloys) has been considered, because it can withstand neutron bombardment. Studies have shown that austenitic stainless steel could withstand a 14 MeV neutron flux of five megawatts per square metre for up to five years. A modified austenitic stainless steel has been developed at the Oak Ridge National Laboratory in the USA that has withstood a 3.5 MW/m^2 neutron flux for two years.

Then there is the blanket to be designed. There are many proposed schemes for removing heat generated in the blanket and converting it into electricity. But although designs do exist, no-one has yet built a cooling system. In concept most designs call for a pressurized liquid coolant, typically water or sodium, to circulate through or around the blanket absorbing heat. Using a heat exchanger, the liquid then heats pressurized water in another closed system.

Economics

When the engineering problems are overcome engineers will have to move on to more conventional concerns like component reliability and operational safety. Power, materials and instrument engineers all still have a lot of work to do.

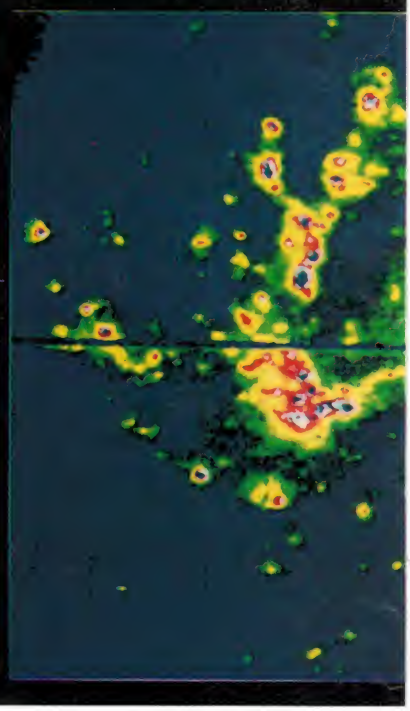
But the debate continues: when will fusion reactors be available commercially and at what cost?

By the year 2000 the US Department of Energy is confident it will be able to decide whether electricity can be economically generated by fusion reactors.

Studies by the Argonne National Laboratory in Chicago indicate that the capital cost of a 1200 megawatt unit will be about $US3 billion in 1984 dollars — which is comparable to the cost of a fission power plant and just a little more expensive than a coal-fired station. But the big plus with the fusion power stations is the far cheaper running costs. ●

TECHNOLOGY

FUSE LAUNCHES AUSTRALIA INTO SPACE



Ted Stapinski

Ted Stapinski is Project Manager of the Starlab group at the Mt Stromlo and Siding Springs Observatories of the Australian National University in Canberra.

THE FAR ultraviolet spectrograph explorer (FUSE) is a joint US, European, Australian scientific satellite which will enable Australian industry to rapidly develop space technology. It will enable Australian industry to prime contract all future Australian space endeavours.

Australia needs an active space program to fulfil its requirements demanded by its large size, its remoteness and reliance on primary industry. We will require many satellites within the next 20 years for communications, defence, meteorology, science and resource management (forest, crop, mineral, water and oceanographic). This can be achieved by the purchase of these satellites from overseas suppliers such as was done with the Aussat satellites from Hughes or by the purchase of services from Intelsat, Landsat, SPOT, etc. However, it means a large export of Australian dollars and does little to establish high technology within Australia. The alternative approach is to establish a space industry within Australia with the capacity to manage projects, perform system design, and manufacture.

It is not sufficient to build subsystems under the prime contractor leadership of a foreign company. This deprives Australian industry of the opportunity to acquire the expertise in large system engineering and high technology project management which is applicable to areas other than space projects.

For future communications and applications satellites many parameters must be optimised for specific Australian needs. Without total system knowledge residing in Australia, they will not be determined and controlled by us, but by outsiders. The current offset program has done little for Australian design capability.

The problem is how Australian industry can extend to high tech from its current position. The answer is to follow the path of other countries with a viable space industry and start off with a science project where some risk taking and experimenting is tolerable. In the pressure cooker environment of commercial communication satellites mistakes are not permissible. Technology and system management are tools that are assumed to be available and in regular use.

However, in order to generate a high political and public profile, this scientific project needs to be a top space science project, judged by world standards. Fortunately such a project exists.

The FUSE project is of strong interest to scientists in the USA and Europe. Australia has been invited to join because of its competence in low light detector technology.

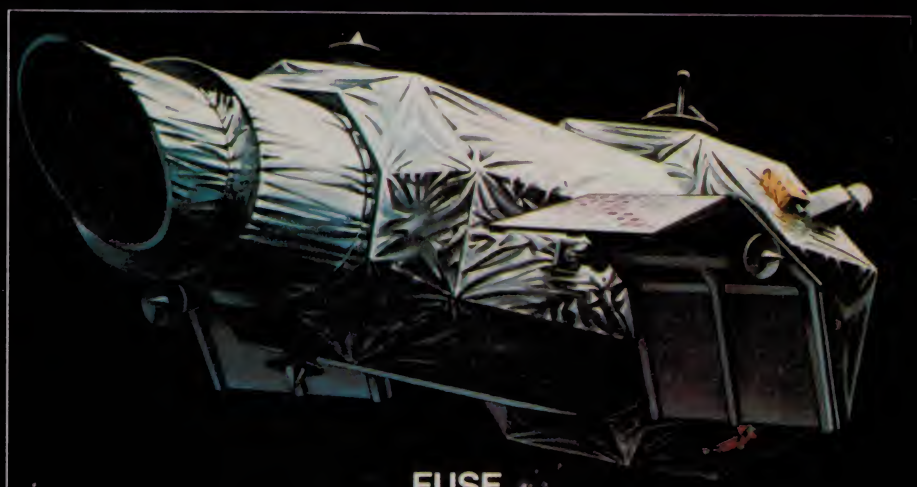
As this is a complex and challenging engineering task, FUSE will not be launched until 1992 or 1993 by either the USA space shuttle or the European Ariane. However, there is some desire to see our detector actually perform in space before committing it to the implementation phase of the project. Thus NASA will make room for a prototype on a shuttle flight in January 1988.

The light detector under test by Harry Tagoris.

The ultraviolet

The FUSE mission will make the first spectroscopic observations of faint sources

In May 1981, ETI reported on Starlab, a combined Australian, Canadian, US ultraviolet space telescope. Starlab never got off the ground, but it did grow up. Five years on, the Project Manager reports on the son of Starlab.



FUSE
(FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER)

▲ **An artist's impression of FUSE.**

◀ **The spiral nebula M83** taken with a prototype of the Lyman light detector.

in the vital far ultraviolet band (90-120 nm) and of any sources in the unexplored extreme ultraviolet band (10-90 nm). Space technology has allowed the exploration of the high energy X-ray, gamma ray, UV, visible and infrared spectral regions. But to date the far ultraviolet band has only been observed by the Copernicus satellite in the early 1970s, and although only the bright stars (stars a little fainter than those visible to the unaided eye) were observed, revolutionary discoveries were made on the state of the gas between stars.

The development of new telescope, instrument, and detector techniques now allows the vital far ultraviolet region to be observed with a capability 50,000 times more sensitive than Copernicus.

The far ultraviolet region is important because molecular hydrogen, a major constituent of the interstellar gas, and deuterium, a crucial cosmological probe, can only be studied in detail in this wavelength region. FUSE will measure simultaneously the amount of cold, warm, and hot plasma in objects ranging from planets to quasars at temperatures ranging from a few thousand to many millions of degrees.

The satellite

The FUSE satellite will be approximately eight metres long by three metres in diameter and will represent the ultimate achievement of advanced technology in optical, electronic and mechanical areas. FUSE is currently being designed so that it could be launched either by the NASA shuttle or by the ESA Ariane launcher and placed in either a geosynchronous orbit or an orbit with a very low geosynchronous period.

FUSE will be controlled by ground stations in USA, Europe and Australia. In Australia, data will be sent via the NASA link to the Deakin Telephone Exchange for distribution to the various astronomical institutions.

The telescope for the FUSE mission has to provide a large collecting area and imaging capability for the ultraviolet wavelength region 10 nm to 200 nm. As efficient reflective coatings are not available for this wavelength region, conventional telescopes working at normal incidence cannot be used. However, at small grazing incidence angles, much higher efficiencies for certain reflective coatings can be achieved.

Grazing incidence telescopes have been traditionally used for the X-ray region and the technology has just been developed to achieve the required image performance for the UV region. The grazing incidence telescope consists of a nearly paraboloid primary mirror and a nearly hyperboloid secondary mirror. The primary mirror effective diameter is one metre but, because it is a grazing incidence design, the mirror is made up of four segments each 2.5 metres long.

Three instruments are required for the FUSE mission. These are the extreme ultraviolet spectrograph (10 nm to 90 nm), the far ultraviolet spectrograph (90 nm to 120 nm) and the ultraviolet spectrograph (120 nm to 200 nm). The ultraviolet spectrograph can use the optimised design that was developed for the Starlab instruments by Australian engineers and scientists. This spectrograph is a conventional design using a schwarzschild camera.

It is proposed that all three spectrographs use the same style of detector based on the Mount Stromlo Photon Counting Array detector. This detector would have an open window image tube, fibre optics image dissector, CCD imagers and photon detection and centroiding electronic circuits.

Current status

NASA, ESA and Australia have signed a letter of agreement which outlines the collaboration between the three agencies. All the committees required to manage and run the project have now been set up. The Joint ESA/NASA/Australia Steering Committee, with two representatives from each country, will manage and coordinate the project. The Joint Science and Technical Team is made up of scientists and engineers from each country and will draft the scientific requirements and oversee the conceptual design. Two tripartite meetings were held in 1985 (the first in Canberra and the second in Washington) to define the scientific requirements of FUSE and to discuss the management of the project.

During the previous four years considerable experience has been built up in the project management and spacecraft subsystem technologies by the Starlab project group. Industries working on the Starlab, Endeavour and FUSE projects have also benefitted. Overseas expertise has been transferred to Australian industry from MATRA, a major French space company to Hawker de Havilland, British Aerospace Australia, Thorn EMI and Dunlop Aviation.

This experience should enable Australian engineers to perform a similar role in advanced communication satellites or earth resource payload. Many of the skills being developed in the FUSE project are directly applicable in these areas.

It is clear that Australian involvement in the FUSE project will develop many of the skills required for future Australian satellites and therefore a significant part of these satellites can be designed, manufactured and tested in Australia. Once this capability is established in Australia, the enormous export potential of this high technology industry, particularly in the Asian region, can be realised. ●

Copyright

by Paul Jones

FOR A MAN of 60 he had a fantastic memory. A storyteller and a grandfather, Ronald was taking his two grandchildren for a stroll through a park when one of them asked for a story. He found a bench, sat down and asked which one they would like to hear. The children thought for a while and together replied *The Golden Temple*.

He looked a little surprised at this for it was a film they had seen only a year ago. He shrugged his shoulders and started to retell the story. Same characters, same names and the same story line. Ron's memory was full of detail and his expressive voice made for easy listening and involvement. About half way through he looked around and found he had built up a small crowd. He stopped for a second. Someone asked him to continue, so he did. When he finished, the crowd moved on leaving him alone with his grandchildren and two police officers.

He looked up at the uniformed men and enquired if he could do anything for them. They smiled, took his name, address and other details, then they asked if he would come to the police station. Ron nodded and was led away.

It was a large, wood panelled, court room. Ron sat in a small box in the centre of the room. Behind him sat the judge and to his right were the lawyers of the film company — which held copyright over the story he had told in the park.

The trial was short, the police reported the events in the park. Ron could not deny these. He was asked if he had seen the film. He said he had. He was asked if he had read the copyright message. He could not remember all of it because he was late in getting to his seat.

The lawyer read the copyright notice aloud to the court, "This screenplay has copyright. None shall copy or reproduce it by any means".

He almost yelled the word "any". Ron asked where he had gone wrong, and was told that "any means" means retelling the story in public.

But it was from memory, not read from a book or played from a recorder, he argued.

It made no difference. He saw their point but thought it petty and left his case there.

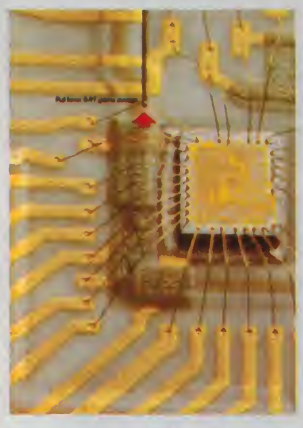
The judge found him guilty by his own confession and asked what settlement the film company required. A detailed account was handed to the judge, and after a time, he looked sadly at Ron and said, "Three hundred and eighty dollars, to be paid within a month, plus costs."

Ron's jaw dropped, he had the cash but it was a dent in his bank account. He walked out of court room and was summoned by a small fellow in a neat, clean suit. "By the way", the fellow said, "the TV network has bought the copyright to this court case, so you are not to tell anyone outside your family, or in public." Ron stood agape. ●

When mainframe power gets this small, Du Pont Electronics will have helped get it there.

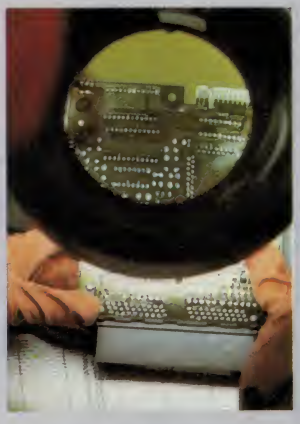
Model of computer is an artist's conception.

Du Pont technology has been helping electronic companies worldwide to develop smaller, more reliable and less costly products for over 20 years.



For example, in 1964 Du Pont's thick film technology helped computer companies develop a new, ceramic circuit which contributed significantly to the reduced size and enhanced performance of computers. Today, this technology permits instant communication between the most complex semiconductor devices for even greater miniaturization.

Du Pont's photopolymer-based dry film technology enabled easier production of high-density, high-reliability printed wiring boards. More recently, this technology led to improved solder masking which also increased circuit density and reliability.



The interconnection of smaller and smaller circuits is aided by Du Pont's connector technology. One result of this technology is the modular jack which links keyboards and personal computers to data transmission networks.

Du Pont's significant contributions often result from developmental "partnerships" in which customers draw on Du Pont's unmatched resources to solve problems faster and move into production quickly and reliably.

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